DOCUMENT RESUME

ED 173 080 **SE 027 821**

AUTHOR	Chalupsky, Albert B.; And Others
TITLE	The Canadian Experience: Implications for Metric Conversion in Education.
INSTITUTION	American Institutes for Research in the Behavioral Sciences, Palo Alto, Calif.
SPONS AGENCY	National Inst. of Education (DHEW), Washington, D.C.
REPORT NO	AIR-65500-6/78-FR
PUB DATE	Jun 78
CONTRACT	400-77-0033
NOTE	128p.; Contains occasional light type
EDRS PRICE	MF01/PC06 Plus Postage.
DESCRIPTORS	*Educational Change; *Educational Strategies; Elementary Secondary Education; *Interviews; *Mathematics Education; *Measurement; *Metric System
IDENTIFIERS	*Canada

ABSTRACT

The findings of a study of metric conversion in Canada are reported, with special attention to its impact on education. Some 40 interviews with metric education leaders in 8 provinces, coupled with an extensive review of documents and correspondence with key individuals in metric conversion throughout Canada, served as the information source for this report. Information is provided on the history and current status of the Canadian Conversion Program, including an overview of the organization and accomplishments of Metric Commission Canada. The results of the study suggest that metric conversion presents an ideal opportunity to evaluate and overhaul the entire program of measurement instruction. (MP)

****
* Reproductions supplied by EDRS are the best that can be made *
* from the original document. *
****

ED173080

THE CANADIAN EXPERIENCE:

IMPLICATIONS FOR METRIC CONVERSION IN EDUCATION

BEST COPY AVAILABLE

ALBERT B. CHALUPSKY

EDWIN M. CARR

SUSAN G. HANSON

U.S. DEPARTMENT OF HEALTH,
EDUCATION & WELFARE
NATIONAL INSTITUTE OF
EDUCATION

THIS DOCUMENT HAS BEEN REPRODUCED EXACTLY AS RECEIVED FROM THE PERSON OR ORGANIZATION ORIGINATING IT. POINTS OF VIEW OR OPINIONS STATED DO NOT NECESSARILY REPRESENT OFFICIAL NATIONAL INSTITUTE OF EDUCATION POSITION OR POLICY

American Institutes for Research

Palo Alto, California

SE 027 821

AIR-65500-6/78-FR

THE CANADIAN EXPERIENCE:
IMPLICATIONS FOR METRIC CONVERSION IN EDUCATION

Albert B. Chalupsky
Edwin M. Carr
Susan G. Hanson

Submitted to:

National Institute of Education
Washington, D. C. 20202

American Institutes for Research
Palo Alto, California 94302

June 1978

This project has been funded with Federal funds from the Department of Health, Education, and Welfare under contract number 400-77-0033. The contents of this publication do not necessarily reflect the views or policies of the Department of Health, Education, and Welfare, nor does mention of trade names, commercial products, or organizations imply endorsement by the U.S. Government.

(c) American Institutes for Research 1978

ABSTRACT

One of the areas of American life that will be significantly affected by metric conversion will be education--formal classroom education as well as training of the adult, non-school population. A great deal can be learned from the experiences of countries that are well ahead of us in meeting the challenges of metric conversion. Canada, especially, represents a wealth of information because of its progress in conversion, particularly since 1975.

This report presents the findings of a study of metric conversion in Canada, with special attention to its impact on education. Some 40 interviews with metric education leaders in eight provinces, coupled with an extensive review of documents and correspondence with key individuals in metric conversion throughout Canada, served as the information source for this report.

Information is provided on the history and current status of the Canadian conversion program, including an overview of the organization and accomplishments of Metric Commission Canada. Metric education policy statements issued by seven provinces are analyzed, and the diverse strategies and schedules for introducing metric education into the schools are discussed. The results of the study suggest that metric conversion presents an ideal opportunity to evaluate and overhaul the entire program of measurement instruction.

The importance of involving teachers, administrators, parents, and the community in metric conversion is apparent from the Canadian experience. Securing top-level commitment, providing authoritative materials, and satisfying the need for continuing communication are essential elements for achieving this involvement.

Selected exemplary programs and materials for metric education are described in the report, and specific recommendations for metric conversion policies and practices in the United States are discussed. One area that merits consideration is the development and use of a national symbol as a means of identifying instructional materials and products that conform to national policies on metric usage.

ACKNOWLEDGMENTS

We are most grateful to the many individuals and organizations that provided the basic information and other assistance which made this report possible. A special note of thanks is due Mr. George Desbarats, Education Sector Plan Manager, Metric Commission Canada, for his invaluable assistance in arranging information contacts in the Provincial Ministries and Departments of Education across Canada and for all the helpful publications he supplied.

We would also like to express our appreciation to the following Ministry and Department of Education representatives for the information and materials they supplied:

Alberta - Dr. Morris Treasure
British Columbia - Mr. Will Dunlop
Manitoba - Mr. William Soprovich
New Brunswick - Mr. A. Hammond
Newfoundland - Mr. O. R. Lawrence
Nova Scotia - Mr. Willis Hall
Ontario - Mr. Robert Stevenson and Mr. Jack Bell
Prince Edward Island - Mr. Sterling Stratton
Quebec - Mr. Guy Richard
Saskatchewan - Mr. Michael Pitsula

Many other individuals in Canada as well as in the United States provided advice during various stages of the project. A sincere word of appreciation is due to Mrs. Marilyn Lister, chairperson of the Metric Advisory Committee of the Consumers' Association of Canada for the information she provided and for the listing of CAC metric coordinators throughout Canada. Assisting us in our early data collection planning was Professor Charles Rhinehart of Sonoma (California) State College.

Throughout the course of this project, Mr. Kent Sullivan, NIE Project Officer, provided enthusiastic assistance and counsel.

Special note should be made of the editorial and secretarial efforts of Ms. Carolyn Davis and her endless patience during the course of the project. Her many suggestions contributed significantly to this report.

Finally, our sincere appreciation to the following individuals who reviewed and commented on the draft manuscript: From Canada - Dr. H. D. Allen, Professor, Nova Scotia Teachers College; Mrs. H. D. Allen, Metric Chairperson, Nova Scotia Branch, Consumers' Association of Canada; Mr. Alexander Norrie, Coordinator of Mathematics, Peel Board of Education, Ontario; Mr. Robert Stevenson, Education Officer, Ministry of Education, Western Ontario Region; Dr. Morris Treasure, Education Consultant, Alberta Department of Education; From the United States - Ms. Audrey Buffington, Maryland State Department of Education; Dr. Paula Platter, Department of Mathematics, Southeastern Oklahoma State University; Mr. Thomas Yack, Wayne-Westland (Michigan) Community Schools; and Dr. Robert Weisgerber, American Institutes for Research.

While we acknowledge the important contributions of all these individuals, needless to say the views expressed, and any errors there may be in the report, are the responsibility of the authors.

TABLE OF CONTENTS

ABSTRACT

ACKNOWLEDGMENTS

I. INTRODUCTION 1

Why Study Metric Education? 1

Following a "Litre" 1

The Major Tasks Accomplished 3

The Chapters To Come 3

II. HISTORICAL REVIEW OF METRIC CONVERSION IN CANADA 5

The "First Step" 5

Weights and Measures Act of 1873 5

"Creeping" Conversion 1873-1970 5

White Paper of 1970 6

Formation of Canada's Metric Commission - 1971 7

National Conversion Events 8

Progress in 1975 8

Progress in 1976 8

Progress in 1977 9

III. A LOOK AT METRIC COMMISSION CANADA AND ITS FOUR-PHASE CONVERSION PROGRAM 11

Committee Structure and Staff Support 11

The Steering Committee 11

The Sector Committee 12

Commission Staff 16

Growth Over the Years 17

The Four-Phase Process for Metric Conversion 17

Investigation Phase 18

Planning Phase 18

Scheduling Phase 21

Implementation Phase 22

TABLE OF CONTENTS (continued)

IV. PROVINCIAL METRIC EDUCATION POLICY STATEMENTS FOR ELEMENTARY AND SECONDARY SCHOOLS 23
Target Date for Predominant SI Usage 24
Provincial Services and Resources 24
Pre-Planning and Gradual Replacement of Materials 24
Costs of Conversion 25
Reassessment of Measurement Instruction 25

V. STRATEGIES FOR INTRODUCING SI INTO SCHOOLS 27
Introduction 27
Strategies and Approaches 27
Alberta 27
Manitoba 28
New Brunswick 29
Newfoundland and Labrador 29
Ontario 29
Prince Edward Island 32
Quebec 32
Saskatchewan 33

VI. INVOLVING TEACHERS AND ADMINISTRATORS IN METRIC CONVERSION . . . 35
Top Level Commitment 35
National Commitment 36
Involvement of School Board and Senior Administrators 36
Encompassing the Entire School 37
The Need for Continuing Communication 38
The Metric Newsletter 38
Surveys of Metric Progress 38
Authoritative Reference Material 43
Other Incentives for Teacher Involvement 44
Providing Released-Time for Teachers 44
Using Tests as an Incentive 44
Don't Lose Your Sense of Humor 45

TABLE OF CONTENTS (continued)

VII. IMPACT OF METRIC EDUCATION ON THE TEACHING OF MEASUREMENT 47

The Need for Restructuring the Measurement Curriculum 47

The Place of Decimals and Fractions in the New Curriculum 49

Alternative Approaches to the Grade Level Sequence 51

VIII. SOME PROBLEMS FACED IN METRIC EDUCATION 55

Educational Materials, Texts and Tests 55
  Metric Training Aids 55
  Texts and Tests 56

Administrative Inertia 56

Teacher Hesitancy 57

Problems with Specific Grades and Subjects 58
  University Level 58
  Science 59
  Nonmeasurement Subjects 59
  Technical/Industrial Arts 60

IX. EDUCATING PARENTS AND THE COMMUNITY IN SI 63

The Need for Parental Support 63

Reaching Out to the Community 65
  Some Views of School Representatives 65
  How Can Community Education Be Improved? 65

Recommendations for Improving Cooperation Between Schools and the Community 68

X. MEDIA AND METRIC EDUCATION 69

The Use of Films, Television and Radio 69

Newspaper Involvement 71

Observations on Media Involvement 71

XI. EXEMPLARY PROGRAMS AND MATERIALS 73

Introduction 73

TABLE OF CONTENTS (continued)

The Metric Guide 73

Calgary Board of Education Metric Project 75
  Feasibility Study 75
  Implementation of Recommendations 76
  Major Areas of Activity 76
  Project Evaluation 79
  Contributions of the Calgary Approach 80

Nova Scotia Teachers College SI Metric Resource Kit 81

Converting to SI in Ontario School Shops 82
  Industry and the Schools 82
  Conversion of Machines and Equipment 82
  Costing 83
  Standardization 83
  Retraining of Teachers in SI 83

Publications of Metric Commission Canada 84
  Awareness Booklets 84
  Posters 84
  "How To" Booklets 87
  "Hang me ups" 87
  Metric Price Comparator 87
  "Metric Monitor" 87

XII. SPECIAL AREAS FOR POLICY DEVELOPMENT 91

Canada's National Symbol for Metric Conversion 91
  Impact of the Metric Symbol in Education 93

Observations on the Metric Commission 95

Related Issues of Interest to Metric Educators 96
  International Dating 97
  The 24-Hour Clock 97

XIII. CONCLUSIONS AND RECOMMENDATIONS 99

REFERENCES 105

TABLE OF CONTENTS (continued)

APPENDIX A - Data Collection Tasks for the Exploration of Canada's Metric Conversion in Education

APPENDIX B - Activity List for Sector 10.01, Elementary and Secondary Schools

APPENDIX C - Advice on How to Avoid Embarrassing Classroom Situations During Early Presentations Using SI Units

List of Tables

Table No. Pages

1 STEERING AND SECTOR COMMITTEE STRUCTURE 13-14

2 PERCENTAGE POINTS OF COMPLETION ASSIGNED TO PLANNING PHASE ELEMENTS 21

3 PERCENTAGE POINTS OF COMPLETION ASSIGNED TO SCHEDULING PHASE ELEMENTS 22

4 ILLUSTRATION OF GRADE LEVELS AT WHICH CANADIAN SCHOOLS ARE TEACHING METRIC MEASUREMENT 51

List of Figures

Figure No. Pages

1 Bar chart for Sector 10.01 (Metric Commission Canada, 1976b) 20

2 Example of complete chart of metric measurement (Alberta Department of Education, 1976) 52-53

3 Organization chart of the Calgary Board of Education Metric Project (Hall, 1977, p.5) 77

4 Example of Canadian poster to encourage "Thinking Metric" 85

5 An example of a "Hang me up" 89

6 Illustration of Canada's National Symbol for Metric Conversion 92

I. INTRODUCTION

Why Study Metric Education?

Following a "Litre"

During the past few years, we have been witness to a revolution in Canada--a nonviolent, but nevertheless radical, change in how most things are measured. This bloodless revolution is all the more amazing since it is being led by the national government with the support of both French- and English-speaking Canadians. Canada, in 1970, announced that it was in the country's best interest to join the vast majority of other countries and switch to the modernized metric system of measurement.* This decision received the backing of all political parties and of a broad cross-section of the country, including the Agriculture Institute of Canada, the Consumers' Association of Canada, the Canadian Chamber of Commerce, the Canadian Teachers' Federation, and the Canadian Home and School and Parent-Teacher Federation.

In the intervening years since the Canadian decision to convert, the United States has gone on record in two pieces of legislation favoring metric conversion. In 1974, the Education Amendments of 1974 (Public Law 93-380) established U. S. policy to encourage educational agencies and institutions to prepare students to use the metric system "with ease and facility." The following year, the Metric Conversion Act of 1975 (Public Law 94-168) committed the government to a national policy of coordinating the increasing use of the modernized metric system and provided for the establishment of a United States Metric Board.

A brief review of earlier history can be found in a previous report of the American Institutes for Research (Chalupsky, Crawford, and Carr, 1974), while a detailed chronicle of events leading up to the U. S. decision to go metric has been published by the U. S. Department of Commerce (1971).

---

*Also known as the International System of Units, or SI. Throughout this report "metric system" and "SI" will be used interchangeably.

Undoubtedly, education is one of the areas of American life that will be most affected by metric conversion, not just formal classroom education but also the massive task of educating the adult, non-school population. During the transition to the metric system, many of us will need to play the role of teacher; but every one of us must become a student, at least for a very brief period. This report does not attempt to teach the metric system. Rather, its mission is to help those who are concerned with planning and designing metric education programs. Readers who are interested in learning about SI should consult an authoritative reference manual such as that published by the National Bureau of Standards (U. S. Department of Commerce, 1977) or the metric style guide of the U. S. Metric Association (1976). Those who would like basic guidance in the teaching of metric measurement will profit from studying an inservice guide published by the California State Department of Education (1975).

This present report describes the third in a series of metric education studies conducted by the American Institutes for Research (AIR) under the sponsorship of the National Institute of Education (NIE). Like its two predecessors (Chalupsky, Crawford, and Carr, 1974; Chalupsky, Crawford, Carr, and McDonnell, 1975), it is based on the rationale that metric conversion in other countries presents an excellent opportunity to learn from the experiences of others who are well ahead of us in meeting the challenges of metric conversion. Its primary goal is to document the history and progress of metric conversion in Canada as it relates to the broad topic of metric education. We hope that our findings will be of value to all who are concerned with improving the educational and communication aspects of metric conversion, not only in the United States but in Canada as well. As Professor H. Don Allen (1976) reported, based on his many years of teacher training in Nova Scotia, "You may learn from us; and before this is over, we'll be learning from you. An optimal change (to SI) will be easier on people, and easier on pocketbooks, so energy devoted to planning and coordination will be well expended" (p.12).

The Major Tasks Accomplished

The study on which this report is based was initiated in March of 1977 and encompassed five major activities:

- Review of a wide range of documents and correspondence received from the Metric Commission in Canada, from representatives of the Ministries of Education in the ten Canadian provinces, and from other leaders in metric education located in eight of those provinces.
- Design of an interviewing guide based on the experiences of AIR project staff, with the advice of six Canadians closely associated with metric conversion in that country and nine consultants representing various levels of education throughout the United States.
- A series of field interviews with 37 educators, two federal representatives, and two consumer representatives in eight provinces.
- A follow-up mail survey covering additional views from 22 of the educators interviewed originally.
- A small-scale survey of the personal views of six provincial metric Coordinators for the Consumers' Association of Canada.

A more detailed outline of the project data collection methods is contained in Appendix A.

The Chapters To Come

The next three chapters present an historical review of metric conversion in Canada, a look at Metric Commission Canada and its four-phase conversion program, and a summary of the metric education Policy Statements issued by seven of the provinces. Following this are eight chapters which present the major findings of our study. The final chapter presents our overall conclusions and recommendations.

3/4

II. HISTORICAL REVIEW OF METRIC CONVERSION IN CANADA

The "First Step"

A modern version of an old Chinese proverb states, "A journey of a thousand kilometres begins with the first step."

Weights and Measures Act of 1873

It might well be said that Canada's "first step" on this 1000 km journey to national metric conversion was the Weights and Measures Act of 1873, adopted by the Second Parliament. This Act contained the statement:

> Notwithstanding anything contained in any act or law in force to the contrary, no contract or dealing shall be deemed to be invalid or open to objection, on the ground that the weights or measures expressed or referred to in any such contract or dealing are weights or measures of the metric system; or on the ground that decimal subdivisions of legal weights and measures, whether metric or otherwise, are used in such contract or dealing. (Boire, 1973, p. 2)

Stated in simpler terms, the Weights and Measures Act of 1873 made legal the use of the metric system and decimal fractions of the customary units in use at that time.

"Creeping" Conversion 1873-1970

Seventeen nations, including the United States, signed the Convention du Mètre (Treaty of the Metre) in 1875 in Paris. It was not until 1907, however, that Canada added her signature to the treaty, which "provided for the fabrication of new and improved standards for metric weights and measures, the establishment and maintenance of a permanent International Bureau of Weights and Measures, and the creation of a general conference as a permanent deliberative body to pass upon international weights and measures matters" (Hopkins, 1974, p.17).

As in several other countries, in the late 1930's, 35 mm cameras and film were becoming popular in Canada. The scientific community had been using metric units for the most part since before the turn of the century. The Canadian pharmaceutical industry converted to the metric system in the early 1960's, and metric units were adopted by many Canadian physicians.

16

Metric conversion in the health and welfare sector was launched by the Canadian Hospital Association in 1966.

Canada's growing involvement in international sports competitions over these years gave to her athletes exposure to 50-metre pools, 100-metre dashes, and 200-centimetre skis. In turn, the citizens of Canada, almost subliminally, began to be exposed to metric terms.

White Paper of 1970

Between 1967 and 1970, there was considerable coverage in the Canadian press devoted to the question of Canadian metrication and a number of national organizations had raised suggestions for action ranging from initiation of studies to immediate adoption of the metric system. In 1968, the Canadian Teachers' Federation had already passed a resolution encouraging conversion to the metric system.

By 1967, most of the major countries of the world, except Canada and the United States, had made the decision to convert to the metric system, by this time known as the International System of Units (SI). In that year, the Canadian Cabinet formed an Interdepartmental Committee for the International System of Units. The studies carried out by this committee led to the "tabling" (i.e., acceptance) in the House of Commons, in January 1970, of the White Paper on Metric Conversion in Canada by the Minister of Industry, Trade and Commerce. On this occasion, the Minister made these comments:

> Changing to the metric system will have important benefits for the Canadian consumer. These benefits will derive principally from the inherent simplicity in general use. The ease of conversion from one metric unit to another--from kilograms to grams, for example--will simplify the arithmetic in making value comparisons of competitive consumer products.
>
> For these reasons and for many others which are indicated in the White Paper, the Government believes that the adoption of the metric system is ultimately inevitable and desirable for Canada. (Boire, 1973, p.5)

Three basic principles of accepted Canadian Government policy in the area of metric conversion were identified in the White Paper (Government of Canada, 1970):

1. The eventual adoption in Canadian usage of a single coherent measurement system based on metric units should be acknowledged as inevitable and in the national interest.
2. This single system should come to be used for all measurement purposes required under legislation, and generally be accepted for all measurement purposes.
3. Planning and preparation in the public and private sectors should be encouraged in such a manner as to achieve the maximum benefits at minimum costs to the public, to industry and to government at all levels. (p.8)

According to the White Paper, the federal government should assume a leading role in the planning and the process of metric conversion. The flavor of the paper is reflected in the following statement:

> The Government accordingly accepts eventual conversion as a definite objective of Canadian policy, and proposes means of study and consultation whereby the pace and the methods of change may be determined in the national interest. No legislative action is contemplated which would make mandatory a general use of metric in place of inch-pound units, although some legislation may prove desirable to foster familiarity with metric units. (p.5)

Although the White Paper stated that information on the metric system should be readily available to the public and that introduction of the metric system should be encouraged wherever the benefits were clear and the costs minimum, no specific time limit was set for conversion.

Formation of Canada's Metric Commission - 1971

In order to implement the objectives of the White Paper, the Government of Canada established its Metric Commission by Order-in-Council in June 1971. The Commission, which reports to the Ministry of Industry, Trade and Commerce, had its first meeting in January 1972. This Commission has the objective of developing an overall national conversion plan. A description of the organization and structure of what is now known as Metric Commission Canada will be presented in Chapter III.

National Conversion Events

Progress in 1975

Metric conversion made its first nationwide impact on Canadians with the reporting of weather conditions. Beginning in April 1975, all temperatures issued by government weather officers were reported in degrees Celsius only. Previous to April 1, dual units had been reported for several months by the media. In September 1975, the Atmospheric Environment Service began reporting rainfall in millimetres and snowfall in centimetres. September 1975 was also the target date for the introduction of SI in many of the elementary and secondary schools. By March 1975, all provinces had set up plans for introducing the metric system into mathematics education programs. Although the Canadian provinces began teaching SI at different levels, the overall target date (endorsed by the Ministers of Education) is that the schools will be predominantly metric by June 1978.*

Progress in 1976

Events proceeded rapidly during 1976. In April, the conversion of weather reporting was completed with the use of metric units for wind speed, atmospheric pressure, and distance. Another 1976 event of major importance was the announcement by the federal and provincial Ministers of Public Works that they would lend their complete support to the construction industry's "M-Day" of January 1, 1978. The import of Construction M Day is shown by the following excerpt from an announcement by the Alberta Housing and Public Works Department to engineering consultants, architectural consultants, general contractors, and design and construction associations in May 1976, which read in part:

> Buildings will be designed metrically in as great a number as is practical, for tendering as soon after January 1, 1978 as is possible. All firms or individuals retained by this department to produce or assist in

---

*According to the Ontario Policy Statement on metric education (Ministry of Education, Ontario, no date), "in a predominantly metric program the student, depending on his or her age and ability, is familiar with appropriate common metric units of length, area, volume, mass, and temperature, and uses these units in school for making and expressing measurements in all areas of the curriculum." (p.5)

> the production of metrically designed projects, which are scheduled to be tendered after January 1, 1978, will be required to produce tender documents, dimensioned and described in the SI metric system of units.

Progress in 1977

In April of 1977, a new $40 000 000[*] program of assistance for those workers whose employers require them to provide their own tools was announced by the Minister of State, Small Business. The program allows such employees to claim reimbursement of 50% of the cost of purchase of new metric tools over a five-year period. A second assistance program was designed to help Canada's retail industry in the conversion of scales or weighing devices. Retail businesses are exempt from payment of federal sales tax on any parts required for metric conversion. Those parts not produced in Canada are allowed entry duty-free. For the purchase of new scales the federal government will forego 50% of the federal sales tax and allow a write-off of such acquisitions in one year under the Income Tax Act. (Robinson, 1978)

After months of debate, Bill C-23, "An Act to Facilitate (Canadian) Conversion to the Metric System of Measurement," became law in August 1977. Originally introduced in November 1976, C-23 is the first of four federal omnibus metric conversion bills. This Act provides for the amendment of 9 of the 90 measurement-sensitive federal Acts which will ultimately have to be changed. Of particular interest to consumers, the Act amends the Weights and Measures Act and allows the Governor General in Council to (a) prescribe a date beyond which a measurement device will not be approved for use in trade unless it is capable of weighing or measuring in metric units and (b) regulate which units of measurement may be used for retail trade and set a date after which only SI units may be used. The original version of C-23 specified that grain producers would report their field

---

[*] In accordance with guidelines from the National Bureau of Standards (U. S. Department of Commerce, 1975) no commas are used to separate groups of digits. These guidelines state that for numbers of five or more digits, the digits should be separated into groups of three, counting left or right from the decimal sign. Instead of a comma, space is left between groups to avoid confusion, since many countries use a comma for the decimal marker. In numbers of four digits, the space is not recommended, unless four-digit numbers are grouped in a column with numbers of five or more digits.

20

crop yield in metric tons per hectare; however, the final bill allowed them to continue using the acre as their official unit of area measurement. The new law also amends the Consumer Packaging and Labelling Act, allowing manufacturers the option to use SI units only, whereas before they were required to use both imperial and SI units on packages having soft conversions.*

Most signs on major provincial highways were converted to the metric system during September and October 1977. Two exceptions, because of political considerations, were Quebec, where the conversion was delayed until December 1977, and Manitoba, where sign conversion was planned for spring 1978.

According to Betty Robinson, a member of Metric Commission Canada (1978), many food items are now sold in metric units, including sugar, ice cream, cottage cheese, yogurt, sour cream, and evaporated milk. Dry pet foods and detergents are also sold in hard-converted sizes.

In August 1977, a Gallup poll of Canadian adults indicated that public opinion was about equally split on conversion to the metric system. Some 46% agreed with the change, 49% disagreed, and 6% had no opinion. Those whose mother tongue is English were more likely to disagree with conversion (55%) as compared with those who first spoke French (45%). Only 29% of all Canadians interviewed reported having "considerable difficulty" in switching to metric units, while 37% reported "some" and 33% "really none."

By the end of 1977, it was obvious that Canada had passed the "point of no return" in metric conversion. Canadians who have been bothered by the change can take consolation in the fact that Canada is nearing its destination of the "thousand kilometre journey" which began with the "first step" over a hundred years ago.

---

*Soft conversion involves the restating in metric units of products designed to English or imperial measure. The actual product size does not change. Hard conversion involves the redesign of products to metric standards.

III. A LOOK AT METRIC COMMISSION CANADA AND ITS FOUR-PHASE CONVERSION PROGRAM

Metric Commission Canada, as noted earlier, was established in June 1971, with its primary role to prepare and coordinate an overall metric conversion program for Canada. One of its major responsibilities is to publish and disseminate information on the progress of, and plans for, metric conversion. The Commission reports to the Minister of Industry, Trade and Commerce and advises the Minister on metric conversion plans and the need for legislation or any other action deemed necessary to facilitate conversion.

Since its beginning, the Commission has had three Chairmen: Stevenson Gossage, who retired as Chairman in 1976 but continues as a Commissioner; C. M. Bolger, 1976-78; and the recently-named D. R. B. McArthur. The originally-named Executive Director, Paul C. Boire, continues to serve in that position. At present, the Metric Commission consists of 18 Commissioners plus the Chairman. The Government's aim in selecting Commissioners was to secure a broad representation from industry and other sectors of the Canadian economy. Care was taken to include representatives from all major geographic regions and from both English and French language groups. The current Commissioners, now in their second three-year term of office, were drawn from the following areas: telecommunications, transportation, heavy industry, mining and metallurgy, cement products, forest products, construction, engineering, food industry, retailing and distribution, agriculture, education, consumer, and labor.

Committee Structure and Staff Support

The Steering Committee

The next level of organization in Canada's metric conversion program is the Steering Committee. Currently, there are 12 such Committees, an increase of two over the original structure. Each Steering Committee is responsible for coordinating a group of related Sector Committees. It reviews and approves Sector Plans prior to their submission to the Metric

22

Commission and oversees the implementation of Sector Plans adopted by the Metric Commission.

During the early years, there were approximately 60 Sector Committees. Today, some 105 Sector Committees are in various stages of developing or implementing their metric conversion plans, according to the Metric Commission's Fourth Report (1977a). This expansion in the number of committees has been due largely to the increase in Steering and Sector Committees responsible for agriculture, food and beverages, which had originally been combined in a single Steering Committee. An overview of the current Steering and Sector Committee structure is presented in Table 1. The Steering Committees are chaired, and usually co-chaired, by Commissioners. Members of the Steering Committees include the chairpersons of the pertinent Sector Committees, plus other representatives of the Sector Committees and/or their relevant associations.

In addition to the ten Steering Committees shown in Table 1, there are two other committees and a working group:

- The Interdepartmental Committee for Metric Conversion is responsible for coordination of metric conversion within the federal government.
- The Intergovernmental Metric Conversion Committee represents Canada's provinces and territories. (This committee receives all draft Sector Plans for review and comment prior to their being recommended for Steering Committee concurrence.)
- The Working Group on Metric Export/Import Trade provides a national forum for nominees from the 12 Steering Committees to discuss the export/import opportunities and problems arising from metric conversion.

The Sector Committee

The responsibility for preparing the original plan and timetable for conversion within a particular Sector, and for monitoring its progress after approval by the Commission, rests with the individual Sector Committee. It is at this level that the majority of the 1900+ volunteers are involved.

Table 1
STEERING AND SECTOR COMMITTEE STRUCTURE*

Sector No.	Sector Title
	Steering Committee #1
1.01	Air Transport
1.02	Railway Transport
1.03	Water Transport
1.04	Road & Urban Transport
1.07	Meteorology
1.20	Working Group on Tariffs
1.30	Working Group on Transportation Packaging
	Steering Committee #2
2.04	Motor Vehicle & Parts Manufacturers
2.05	Truck Body & Trailer Manufacturers
2.06	Railroad Rolling Stock
2.07	Shipbuilding & Ship Repairing
2.08	Heating, Ventilating, Air Cond. & Food Service Equipment
2.09	Plumbing & Hydronic Heating
2.10	Iron & Steel Mills & Foundries
2.11	Fasteners Industry
2.21	Metal Stamping, Forming, Pressing, Coating
2.22	Can Manufacturers
2.23	Cookware & Housewares
2.24	Hand Tools & Measuring Devices
2.25	Builders & Home Hardware
2.27	Fire Fighting Equipment & Operation
2.28	Wire & Wire Products
2.31	Construction & Agricultural Equipment
2.32	Machinery & Fluid Power
2.33	Metal Working Machines, Machine Shops, Tool & Die Shops, Cutting Tools
2.34	Recreational & Leisure Products, Off Road Vehicles, Outdoor Power & Specialized Equipment
	Steering Committee #3
3.01	Electrical Manufacturers
3.02	Radio, Television, Communication, Electronic Equipment & Parts
3.03	Aircraft & Aircraft Parts Manufacturers
3.04	Business Machines, Scientific & Professional Equipment
3.05	Communications
3.06	Electric Power
3.07	Rubber Products
3.08	Chemicals & Chemical Products
3.09	Plastics Industry
3.10	Working Group on Scales in the Retail Food Industry
	Steering Committee #4
4.01	Mines
4.02	Petroleum & Natural Gas Industry & Services
4.03	Petroleum Refineries, Wholesalers & Gasoline Service Stations
4.04	Natural Gas Distribution & Transport
4.05	Non-Ferrous Metals
	Steering Committee #5
5.01	Construction
5.02	Non-Metallic Mineral Products
5.03	Structural & Architectural Metals
5.05	Real Estate, Land Surveyors & Town Planners
5.06	Road Design, Construction & Operations

(continued)

---

*Source: Metric Commission Canada, February 1978 listing

Table 1 (continued)

Sector No.	Sector Title
	Steering Committee #61-Agriculture, Fishing, Trapping
61.01	Bulk Grain Handling Industry
61.02	Feed Industry
61.03	Poultry
61.05	Horticulture
61.06	Fishing & Fish Products
61.08	Seed
61.09	Tobacco Farmers
61.10	Tobacco Products
	Steering Committee #62-Food
62.02	Confectionery
62.03	Meat Packers
62.04	Dairy Processors
62.05	Food Processors
62.06	Pet Foods
62.07	Biscuits
62.08	Edible Oils
62.09	Sugar
62.10	Bakers
62.11	Tea & Coffee
62.13	Millers
62.21	Cold Cereals
62.22	Hot Cereals
62.23	Spices, Extracts & Food Colouring
62.24	Cold Beverages, Mixes & Dry Dessert Mixes
62.25	Chocolate Drinks & Cocoa Powder
62.26	Pasta Products
62.27	Baking Mixes
62.28	Snack Foods
62.29	Rice
62.31	Salt
62.50	Working Group on Packaging
	Steering Committee #63-Beverages
63.01	Distilled Spirits
63.02	Breweries
63.03	Soft Drinks
63.04	Wine
63.06	Mineral Water Producers
63.08	Cider
	Steering Committee #7
7.10	Textiles
7.20	Clothing
7.30	Leather (Footwear)
7.41	Jewelry
7.42	Sporting Goods
7.43	Toys
7.45	Brush, Broom & Mop
7.49	Luggage & Leather Goods
	Steering Committee #8
8.10	Forestry
8.17	Urban Forestry/Arboriculture
8.20	Wood
8.30	Furniture & Fixtures
8.45	Paper & Allied Ind., Printing & Pub.
	Steering Committee #9
9.10	Health & Welfare
9.21	Amusement & Recreation
9.30	Services to Business Management
9.40	Accommodation & Food Services
9.50	Consumers, Home Economics & Retailing
9.51	Retail Trades
9.60	Labour Organizations
9.70	Personal Services
	Steering Committee #10
10.01	Elementary & Secondary Schools
10.03	Post Secondary Non-University Education
10.04	Universities & Colleges

Of particular relevance to this report is the composition and role of the Sector Committees concerned with education. Following is a description of the three educational Sector Committees:

10.01, Elementary and Secondary Schools
10.03, Post-Secondary Non-University Education
10.04, Universities and Colleges

It should be stressed that the role of these committees is strictly advisory in keeping with the fact that education is the responsibility of the provincial departments of education and the local school boards. While considerable planning and guidance material was developed by these committees, by far the major influence on educational policy and scheduling came from the departments of education of the individual provinces. This was especially true for elementary and secondary education where the Metric Task Force of the Council of (Provincial) Ministers of Education had the responsibility to prepare recommendations for transmission to the provincial departments of education across Canada.

Sector 10.01, Elementary and Secondary Schools. Of the eight members on this committee, three come from the federal government (two from the Commission and one from Indian and Northern Affairs), one from the Council of (Provincial) Ministers of Education, and the remainder from the following associations:

- Canadian Teachers' Federation
- Federation of Catholic Schools of Quebec
- Canadian Home and School and Parent-Teacher Federation
- Canadian School Trustees Association

Sector 10.03, Post-Secondary Non-University. The 11 members on this committee come from eight different provinces. Four are located in provincial ministry offices concerned with post-secondary education, two come from educational institutions, and two from the Metric Commission. The Further Education Services Association of Continuing Education, the Newfoundland Teachers' Association, and the Standards Council of Canada are also represented.

Sector 10.04, Universities and Colleges. Four universities in the provinces of Ontario, Newfoundland, Quebec, and Alberta each have a representative on this committee. In addition, two members are from the Association of Universities and Colleges of Canada, two from the Metric Commission, and one from the Standards Council of Canada.

Commission Staff

Supporting the work of Metric Commission Canada and responsible to the full-time Executive Director are the Research and Planning Directorate, the Information Directorate, the Engineering Industries Plans Directorate, the Industry and Services Plans Directorate, and the Directorate of Intergovernmental Co-ordination.

The Research and Planning Directorate provides guidance to all Sector Committees in the application of network planning methodology and progress monitoring. The responsibility for the production of Sector Plan documents and for the development of improved planning methodology rests with this Directorate. Other services include parliamentary liaison, maintaining an information storage and retrieval system, operating a reference service, and reviewing relevant materials. The office having the greatest contact with the general public is the Information Directorate. As described in the latest progress report (Metric Commission Canada, 1977a), this Directorate is responsible for a wide range of public relations activities, including:

- Developing public relations campaigns.
- Producing news releases and information kits for the mass media. During fiscal year 1977, this included a series of 25 sponsorable public programs for AM and FM radio stations, two television specials, a continuing series of media seminars, and the organization of a freelancers' bureau to encourage and assist freelance writers of metric stories.
- Developing exhibits and displays. A total of 48 exhibit appearances were made across Canada during fiscal year 1977, including trade fairs, conventions, shopping centers, conferences and seminars. Information material was given to approximately one million Canadians.
- Coordinating a volunteer speakers' bureau.

- Staff participation in interview shows.
- Developing and maintaining an audiovisual library. Currently, some 67 film titles and approximately 3000 slides are available on a loan basis.
- Production of books, pamphlets, and posters, representing more than 20 titles during fiscal year 1977. In addition, some 10 Sector Plans and 28 summary fliers were printed; and the monthly newspaper Metric Monitor reached a circulation of 160 000 during the year.
- Responding to public inquiries. Some 38 500 requests for information were received during the year ending March 1977.

Growth Over the Years

In keeping with the expanding metric activity since its inception, the number of Metric Commission Canada staff rose from 40 in fiscal year 1973 to 61 in 1975 and 89 in 1978. Shown below is the growth in expenditures beginning with fiscal year 1973, the first full year of operation.

Fiscal Year (April 1 to March 31)	Expenditures
1972-73	$ 530 443*
1973-74	$1 590 792
1974-75	$2 634 101
1975-76	$3 316 100
1976-77	$4 380 300
1977-78	$5 897 000

*Figures obtained from the Metric Commission's second, third, and fourth progress reports (1975, 1976a, 1977a) except for 1977-78, which was obtained by interview.

The Four-Phase Process for Metric Conversion

The program of guideline dates for metric conversion recommended by Metric Commission Canada (MCC) in 1973 established four phases as a means of measuring progress toward the goal of metric conversion in Canada: Investigation, Planning, Scheduling, and Implementation.

Investigation Phase

During the last half of 1971, alternative approaches used in other countries were studied by the MCC. It was then decided that the initial approach in Canada would be by means of a letter-questionnaire to over 200 national associations, with all sectors of the Canadian economy represented.

During the first half of 1972, attention was directed to the formation of Steering Committees. Some of the more important aspects of organization that needed resolution were areas of responsibility, allocation of Sectors to Committees, nominations for membership of Committees, and staff roles. By the middle of 1972, the questions which arose pertaining to these aspects were, for the most part, resolved. The last step in the Investigation phase was the actual formation of the Steering and Sector Committees which, as noted earlier, were given the individual responsibility to consider the objectives, policies, and strategies of metric conversion.

Another aspect of the Investigation phase was the research required in each industry or occupation to define appropriate SI units to be used, metric standards to be employed, and the range of sizes or quantities to be used in metric production activities. The Investigation phase, on schedule, reached its peak at the end of 1974 and was completed by the end of 1975.

Planning Phase

The Planning phase follows a model developed for the Commission by management consultants. The model contains a rather elaborate planning network, sufficiently detailed to contain the essential activities and events which comprise metric conversion within a Sector. Each Sector Plan document consists of five elements:

1. Plan Description
2. Activity Breakdown
3. Activity List and associated Activity Descriptions
4. Network Diagram
5. Bar Chart

To provide a feeling for the techniques used in this phase, a summary of these elements is presented next.

Plan Description. The major topics in the Plan Description are objectives, policy statements, strategies to be employed, key event dates (with present status), and guidelines for the use of the Sector Plan by organizations preparing their own plans.

Activity Breakdown (first step in Planning phase). This element contains the identification of major activity areas in the Sector Plan which will require expenditures of both time and funds.

Activity List and associated Activity Descriptions. This element contains explanations of the nature of each activity to be carried out. It includes objectives, identification of those responsible for execution of each activity, outlines of the efforts involved, and criteria for measurement of progress. The Activity List for Sector Plan 10.01 (Elementary and Secondary Schools) will be found in Appendix B.

Network Diagram. The Sector network is a flow diagram of the Sector activities which must be accomplished to reach conversion objectives. The Network Diagram depicts the planned sequences of accomplishments and the interdependencies and interrelationships of activities. The diagram also includes the estimated duration of each activity or group of activities and their timing. As is standard in this type of activity diagram, those activities whose delay will cause an overall delay of metric conversion in the Sector are located on a critical path, the path which determines the total estimated time required to implement the Plan. The Network Diagram also identifies interdependencies with other Sectors which could affect the successful attainment of target dates.

Bar Chart. This element of the Sector Plan, derived from the Network Diagram, summarizes the time spans of the major areas of activity and identifies the location of key events in the total duration of Plan implementation. The Bar Chart for Sector Plan 10.01 is shown in Figure 1.

Although the Plan Description appears as the first element in each Sector Plan, it is actually the last of the five elements to be completed. Upon the completion of the Sector Plan draft, it then undergoes several levels of review. After the Sector and Steering Committees, in turn, have reviewed and incorporated any necessary modifications to the Plan, the draft is referred to the Commission for final approval, publication, and dissemination.

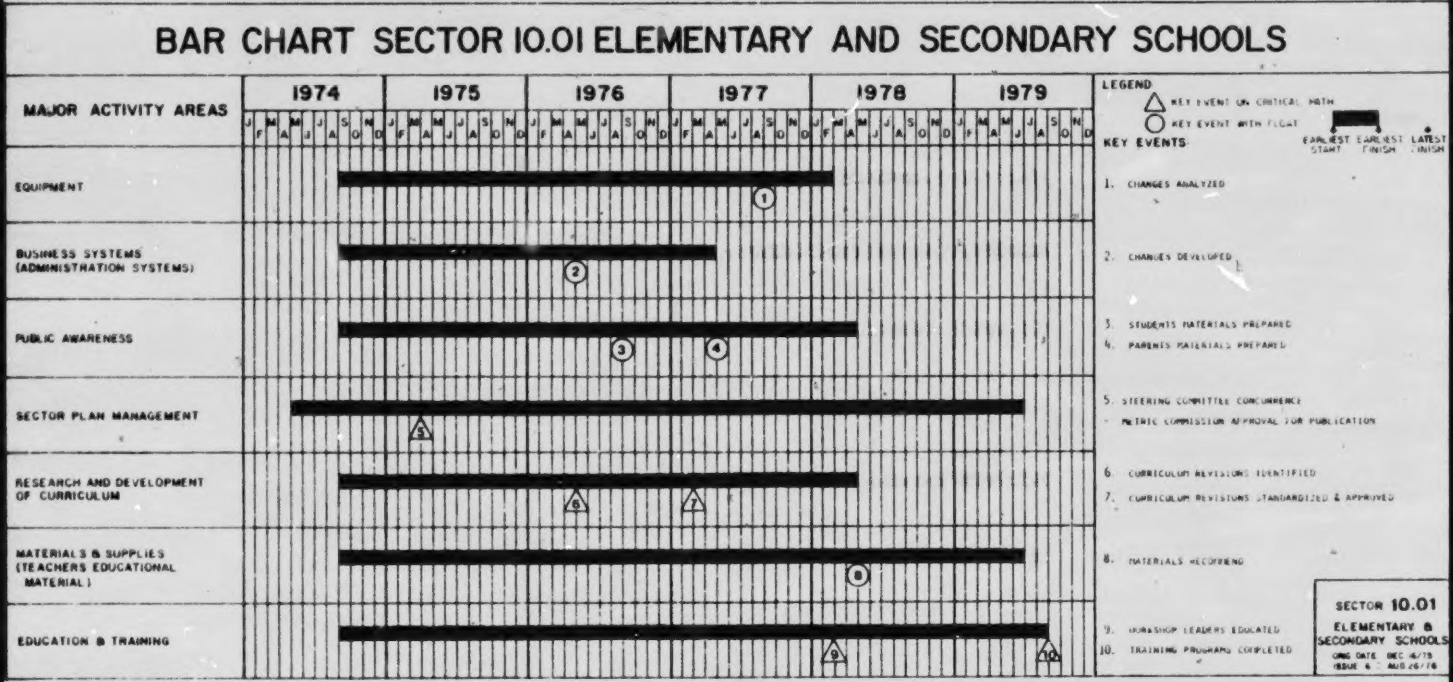


Figure 1. Bar Chart for Sector 10.01 (Metric Commission Canada, 1976b).

The Planning phase has been broken down into percentage points of completion, as shown in the table below. The percentage points are admittedly arbitrarily determined; nevertheless, they serve as quite useful indicators of progress within the Planning phase.

Table 2

PERCENTAGE POINTS OF COMPLETION
ASSIGNED TO PLANNING PHASE ELEMENTS

Accomplishment	Cumulative Percentage of Planning Phase Completion
Sector Plan Development:	
Activity Breakdown	10
Activity List	30
Network Diagram	50
Bar Chart	60
Plan Description	70
Review and Approval:	
Sector Committee	80
Steering Committee	90
Commission	100

The Planning phase is now well past its peak. It was scheduled to have been completed by the end of 1975-76. It is behind schedule by about two years.

Scheduling Phase

The Scheduling phase actually overlaps the Planning phase and is considered to begin when the estimated time durations and the start and finish dates are assigned to the draft network of activities. The Scheduling phase is also broken down into percentage points of completion, as shown in Table 3.

The Scheduling phase is considered to be 100% completed when six months have elapsed after Commission approval, providing no serious requests to change the Schedule have been received by the Commission. Scheduling was approximately 50% completed by March 1977 (Metric Commission Canada, 1977a).

Table 3
PERCENTAGE POINTS OF COMPLETION ASSIGNED TO SCHEDULING PHASE ELEMENTS

Accomplishment	Cumulative Percentage of Scheduling Phase Completion
Draft Network assigned a start and a finish date	30
Draft circulated to relevant Sectors for comment	40
Examination of draft by provincial contacts	50
Referral of draft Plan to Steering Committee	60
Steering Committee concurrence	70
Referral of draft Plan to Commission	80
Approval for publication by Commission and dissemination of first Plan summary flyer	90

Implementation Phase

The Implementation phase is considered to be the final stage of metric conversion, in which each Sector and/or individual organization implements their Plan according to the schedule defined in the Scheduling phase. However, the situation can arise where some implementation activities are initiated during the Planning and Scheduling phases.

Implementation is guidelined to peak in early 1978 and then to taper off to completion at the end of 1981.

IV. PROVINCIAL METRIC EDUCATION POLICY STATEMENTS FOR ELEMENTARY AND SECONDARY SCHOOLS

In Canada, education is strictly a provincial responsibility and one that is jealously guarded. Accordingly, the educational Sector Plans of the Metric Commission were issued as guidelines only, as noted earlier. Indeed, the Sector Plans were often ignored at the provincial and local levels, according to a number of our interviews. Most provinces felt the need to issue their own individual policy statements pertaining to metric conversion in education. Ontario, for example, published its policy statement (Ministry of Education, Ontario, no date) more than a year before the Sector Plan for Elementary and Secondary Schools was approved by the Metric Commission.

Metric education policy statements were obtained from seven provinces: Alberta, Manitoba, New Brunswick, Nova Scotia, Ontario, Quebec, and Saskatchewan. The Government of British Columbia, it was learned during the course of this study, had prepared a policy statement on metric conversion a few years ago, just before a change in the provincial government. As yet, the statement has not been officially released. No official policy statements were received from Prince Edward Island or Newfoundland and Labrador; however, information on strategies for introducing the metric system into schools in these provinces is available and will be presented in Chapter V.

All seven policy statements commit their respective provinces to the use of SI as the predominant system of measurement in provincial curricula. These policy statements will be reviewed together in terms of the following major areas:

- Target date for predominant SI usage
- Provincial services and resources
- Pre-planning and gradual replacement of materials
- Costs of conversion
- Reassessment of measurement instruction

34

Target Date for Predominant SI Usage

Five provinces name June 1978 as the target date for predominant use of SI. Nova Scotia policy states, "In mathematics P-12, only metric measures should be used in the school year beginning September 1977.... By 1980 references to imperial units in school programs should be historical in nature and will be used only in replacement of parts of equipment built in...the imperial system" (Nova Scotia Department of Education, 1977, p.18). Only the province of Quebec indicated as mandatory the deadlines established by government and industry. Its policy statement reads, "The change-over to SI must...follow the deadlines set up by government and industry" (Sauve, 1977,p.24). New Brunswick's "predominantly SI" target date is June 1980. (New Brunswick Department of Education, 1975).

Provincial Services and Resources

Four provinces, Alberta, Manitoba, Quebec, and Saskatchewan, specifically offer the services of consultants and/or inservice training personnel, although the extent of such resources varies from province to province. For instance, Alberta policy states,

> Conversion will be accomplished by means of existing administrative structures and there will be only a minimum number of short-term special assignments associated with the change to SI. (Alberta Department of Education, no date)

The Department of Education of Saskatchewan, on the other hand, has hired a full-time inservice workshop leader and coordinator for the province.

Pre-planning and Gradual Replacement of Materials

Five provinces, Alberta, Manitoba, New Brunswick, Ontario, and Saskatchewan, have acknowledged the importance of pre-planning and the gradual replacement of materials in their policy statements. For instance, Manitoba policy states,

> Emphasis is placed on the importance of pre-planning and a pattern of gradual change that takes into account the normal rate of attrition, and possible modification and supplementation, of existing learning materials and the availability of new learning materials. (Manitoba Department of Education, 1975, p.2)

Costs of Conversion

The provinces of Alberta and Quebec make definitive statements concerning costs of conversion. Quebec worded it as follows.

> The cost of the changeover will be the responsibility of each administrative unit of the Ministry of Education of Quebec and each school organization. (Sauve, 1977, p.24)

Alberta's statement conveyed the same idea; that costs "lie where they fall."

On the other hand, while not specifically included in its policy statement, Ontario made available a grant allotment of 75 cents per student for each of three years for the purpose of assisting schools in their purchasing of metric materials.

Reassessment of Measurement Instruction

Two provinces, New Brunswick and Ontario, make mention in their policy statements of the opportunity in metric conversion to reassess the teaching of measurement.

> Metric conversion (should) be accepted as an opportunity to reassess pedagogical approaches toward the topic of measurement as a whole;...students (should) be provided with opportunities to acquire a practical and experiential knowledge of metric units through activities that involve comparing, estimating, measuring and related problem solving; and...teachers and students (should) be encouraged to design and construct appropriate measuring devices to be used in conjunction with selected commercial equipment. (Ministry of Education, Ontario, no date, p.2)

This does not mean that other provinces have not recognized this opportunity; they have, as discussed in Chapter VII of this report.

Saskatchewan policy included two areas which were not mentioned by the other provinces:

- Teaching of conversion. "Conversion from the Imperial...to the Metric System...should not be taught. Rather, [they] should be treated as independent systems of measurement with a deliberate emphasis being placed on the ability to use the Metric System."

- Parent awareness. "Teachers should assume some responsibility in providing opportunities for parents to become informed about the role of the school in the change to the Metric System of Measurement" (Saskatchewan Department of Education, 1975b, p.3).

While the majority of provincial policy statements were in agreement on the target date for school changeover to SI, considerable variation exists across the provinces in the strategies for achieving this changeover. Illustrations of these differences in strategy are presented in the next chapter.

V. STRATEGIES FOR INTRODUCING SI INTO SCHOOLS

Introduction

During the course of our investigation, we found a wide diversity of philosophies among provincial guidelines for introducing SI into the schools. The metric education strategies of the local school systems were also found to differ significantly, ranging from the gradual introduction of SI by subject and grade to the "shotgun" or "blitz" approach.

Strategies and Approaches

Alberta

The approach. The Alberta Department of Education, in its newsletter, SI (February 1976), indicated that there "seemed to be a fairly good consensus" that a "blitz" approach was desirable. In other words, SI should be introduced into all grades of a school at the same time. It was mentioned that a large number of schools were planning to use this approach beginning September 1, 1976. The Department recognized, however, that a major problem existed in this approach.

The problem. Consider a grade 5 student who has to change "measurement horses" in midstream. This student has had four years of indoctrination with imperial units and knows and uses the now "objectionable four-letter words such as inch, foot, yard, mile, peck, pint and acre" (Alberta Department of Education, 1976). With a four-year exposure to the imperial system of measurement, how can a 100% metric philosophy be imposed upon this student?

The solution. It was proposed, taking grade 5 as the example, that the metric ideas and skills developed in the first four grades should be presented to the grade 5 student in a "mini-Metric Blitz" to enable the student to adapt to an all-metric program. The catch-up ideas and skills would not be a mere compilation of the previous programs but would have the degree of sophistication necessary to gain the attention and interest of the fifth grader.

A variation of the blitz approach, in which all grades were converted whenever and wherever possible, was initiated by the Calgary Board of Education in 1974. Labelled a "broken front" approach by its coordinator, this program will be discussed in Chapter XI.

Manitoba

Provincial-level educators felt that if implementation were to be effected within a reasonable time period, it would be necessary to introduce SI into several grades in a single year. This was felt to be especially important at the elementary level, where measurement concepts and units have general application across all subject areas. Simultaneous introduction of metric measures in specific subjects at the secondary level, such as mathematics and science, was also considered necessary.

The time-frame and pattern of implementation were suggested as follows:

Grades	1974-75 and 1975-76	1976-77	1977-80
K-3	SI only (when standard units are introduced)		
4-5	Initiation of activities	SI only	
6-12	Initiation of activities	Initiation of activities	SI only

"SI only" was interpreted as the predominant use of metric measures, while "Initiation of activities" referred to introductory and supportive activities to help the students become aware of the fundamentals of the metric system and develop a positive attitude toward its use. The initiation process was a first-step toward total integration of SI into the regular curriculum.

Some examples of activities were:

- Metric days involving total school staff, students, and parents
- Metric activity centers
- Topical or thematic approach: (a) history of measurement systems and (b) effects of SI on Canadian life
- Conversion of imperial-based topics and programs already in school system

New Brunswick

In New Brunswick, June 1980 was set as the latest date by which the Department of Education expected a school to convert to a predominatly metric system of measurement (New Brunswick Department of Education, 1975). The peak periods of metrication were keyed to anticipated textbook changes in the period 1976-1980 as follows:

• Elementary Schools	1977-1980
• Junior High Schools	1976-1979
• Senior High Schools	1976-1980

The New Brunswick Department of Education suggested that metric conversion would be more effective if school staff planned cooperatively for the event.

> If students of a certain level are to begin using metric units of length in mathematics, then these units should also be used in art, drama, athletics, science, language arts, creative projects, scale drawings, mapmaking, or wherever linear measurement is used. (p.9)

Newfoundland and Labrador

In Newfoundland and Labrador the schedule for metric conversion in mathematics is as follows:

Grades	Years of Implementation
K-3	1977-78
4-6	1978-79
7-8	1979-80

Metric conversion in subjects other than mathematics is planned to occur as textbooks are introduced through a normal process of attrition, with no formal target dates. A consultant was hired on a contractual basis to conduct inservice workshop training for school staff.

Ontario

As mentioned previously, a target date of June 1978 for changeover completion was proposed by the Ministry of Education in 1975. Schools were given the freedom to implement changeover before 1978 if they so desired. In some schools metric activities were under way as early as 1971, and by

1975 there were already a few elementary schools whose programs were almost totally metric. Others had not yet begun a planning phase. In order for both the elementary and secondary schools to meet the target date, it was advised that implementation should start no later than the beginning of 1976.

The approach to implementation of SI in elementary and secondary schools at the local level in Ontario varied from individual grade-by-grade process to the blitz or "shotgun" method. For instance, in London, Ontario the original time-frame called for implementation in grades K-1, starting in September 1973 and moving up one grade each year, with grade 8 completed by 1980 and secondary grades by 1981. It was reported that this strategy provided an incentive to teachers while giving them adequate time for preparation without undue pressure. This schedule was modified, after the issuance of the provincial policy statement, to completion of grades 7 and 8 in 1975-76 and secondary schools by 1978.

Windsor Public Schools, on the other hand, planned to convert grades K-2 in 1974-75 and the remaining elementary grades to grade 8 in 1975-76. The Windsor secondary schools, faced with imperial texts, were moving rather slowly and informally toward SI, except in science classes.

The Windsor Separate School System (Roman Catholic) in 1971 began using a blitz or "staggered blitz" approach. The blitz consisted of total immersion of all school personnel, all subject areas, and the majority of time over a one- or two-week period. The staggered blitz allowed for concentration on only one aspect of measurement at a time, progressing through one-, two-, and three-dimensional measurement, mass, time, and temperature. Each aspect covered one week of activity with a week of assimilation and application of concepts interspersed between the weeks of activity. The entire process in a school would cover a period of seven weeks if implemented completely (Ontario Teachers Federation, 1973). Subsequent implementation was not grade-sequenced but involved the entire elementary school. It was estimated that, as of September 1977, 70-80% of the elementary schools were using SI as the predominant system of measurement.

Ottawa planned its conversion to cover a three-year period, beginning with grades K-6 in the 1974-75 school year, and continuing with grades 7-10 in 1975-76 and grades 11-13 in 1976-77. Public school authorities in Ottawa felt that the grade-by-grade sequence was too slow, with undue waste of time and funds. One Ottawa respondent felt that K-8 should have changed over as a block, since an elementary school building in Ottawa typically contains grades K-8.

The Middlesex County Board of Education, in October 1976, chose a combination approach using experimentation followed by implementation. The schedule allows time to produce a comprehensive development plan and to effect a smooth transition from grade to grade. This approach is illustrated below.

School Year	Implementation	Experimentation
1975-76	1. Grade 3	1. Grade 4 2. Grades 7 & 8 (awareness) 3. Integration of metric in other elementary school subject areas 4. Secondary schools planning and experimentation for metric conversion
1976-77	1. Grade 4 2. Grades 7 & 8 (awareness) 3. Integration of metric in other elementary school subject areas 4. Secondary school metric conversion	1. Grade 5
1977-78	1. Grade 5 2. Integration of metric in other elementary school subject areas 3. Secondary school metric conversion to the predominant use of metric units to be completed by June 1978	1. Grade 6
1978-79	1. Grade 6 2. Integration of metric in other elementary school subject areas	
1979-80	Adjustments to grade 7 & 8 programs necessary to complete the K-8 metric program	

Prince Edward Island

The time table for introduction of SI into the mathematics curriculum was planned as follows.

Grades	September 1977	September 1978	September 1979
All	Supplementary materials in conjunction with current textbooks		
1-3	Selected pilot classes totally SI	SI only in all classes	
4-6		Selected pilot classes totally SI	SI only in all classes
7-9	Selected pilot classes totally SI	SI only in all classes	

It was planned that in grades 10-12 totally metric mathematics materials would be introduced as they became available. The use of supplemental materials in addition to existing textbooks in mathematics gave time for review of new publications and for selection of "second generation" texts containing major changes in the strategies of teaching measurement, instead of merely converting "inch" problems to centimetres. In subjects other than mathematics, the philosophy was to implement conversion as textbooks became available.

The Prince Edward Island Department of Education approach could very well be described as a slow, subtle, non-event.

Quebec

The Ministry of Education established the schedule for the province. The schedule in Quebec contained both optional and mandatory elements of implementation as follows:

Grades	School Years of Implementation		
	1975-76:	1976-77:	1977-78:
1-3	optional	mandatory	
4-6		optional	mandatory
7-9	optional	mandatory	
10,11		optional	mandatory
all			mandatory

Saskatchewan

In its policy statement, published in July 1975, a three-year gradual process of conversion was proposed by the provincial department of education. The following timeline was recommended:

Grades	Date
1-3	1975-76 (on schedule)
4-6	1976-77 (on schedule)
7-12	1977-78

It was suggested that teachers, in the process of implementation, attempt to provide to students relevant contexts such as changes in weather forecasts, highway signs, and food packaging (Saskatchewan Department of Education, 1975b.

The Saskatoon Board of Education felt that the provincial timeline was too long and decided to move up their schedule by at least one year. There has been no formal phasing in of conversion in the school system by grade level. Grades 7 and 8 moved more quickly and were the first grades to prepare for a curriculum change. The explanation for this was that seventh and eighth grade teachers are more "specialist" than teachers of grades K-6, and they quickly picked up metric conversion as a "great idea." Teachers of grades K-6, on the other hand, typically delayed their changeover until the official curriculum changes were published.

VI. INVOLVING TEACHERS AND ADMINISTRATORS IN METRIC CONVERSION

Throughout our travels across Canada, one of our primary concerns was to obtain suggestions for improving the effectiveness of teachers and educational administrators in SI. Experienced instructors, many of whom had been heavily involved in metric education since 1974, or before, provided us with a wealth of suggestions. To the surprise of no one, we found overwhelming support for the activity-based teacher workshop, ideally using quality materials (either commercial or "home-made"). The need for manipulatives was universally accepted as a sine qua non of metric education in Canada. The importance of such training has also been recognized in other countries (Chalupsky, Crawford, Carr, and McDonnell, 1975) and is now generally accepted by educators active in the field of metric education. Accordingly, we have chosen not to dwell on the obvious but rather to highlight some of the lesser known factors which deserve attention in the planning of metric education programs. The major topics to be covered are:

- Top-Level Commitment
- The Need for Continuing Communication
- Authoritative Reference Materials
- Other Incentives for Teacher Involvement

Top-Level Commitment

Successful achievement of major organizational change, of any type, rests heavily on the extent to which top management is involved. Conversion to the metric system epitomizes this management principle because whatever change is necessary at the school level flows directly from the national goal of going metric. Metric education, unlike "modern mathematics" is not just another curriculum innovation. The earlier success of metric education in Australia, for example, and the significant progress now being made in Canada, are ample testimony to the impact of top-level commitment at all levels of government and education.

The results of our analysis of Canadian documents and the face-to-face interviews we conducted with leaders in Canadian metric education reveal three major indicators of commitment:

1. National commitment
2. Involvement of school board and senior administrators
3. Encompassing the entire school

National Commitment

A cornerstone of metric education in Canada has been the fact that the country is officially going metric. Educators from the start of their heavy involvement in metric education never really had to be concerned over whether or not metric conversion would ever come about; rather, the choice of many was whether they wanted to lead or to follow. As early as 1973, plans were being made by appropriate governmental agencies for conversion to occur in areas such as weather reporting (beginning in 1975) and highway signs (in 1977) that were to impact directly on every Canadian resident, as well as every visitor (American National Metric Council, November 1973). Real-life things were happening and realistic schedules of future events were being prepared by the Metric Commission with the assistance of some 1000 to 2000 Canadians across the country. Educators had no cause to feel alone or to feel vulnerable to charges of being "part of a conspiracy" as they did in Great Britain (The Bookseller, March 1971, p.1662), or as some educators may feel today in the United States.

Also reflecting this national commitment were the metric education policy statements issued by most of the provinces, as noted previously. The educators we talked to clearly recognized the importance of this national and provincial leadership. The only concern we heard from several educators was that their work would have been easier if the provincial policy statements had been issued earlier and if there had been even more definitive support and "pressure" from the provincial Ministries.

Involvement of School Board and Senior Administrators

"When the board is enthusiastic, everything else falls into place." This is how one administrator in Alberta summed up the need for school board involvement. In Calgary, for example, one of the trustees served on the Metric Education Feasibility Study Committee which presented its report to the board in March 1974. Her participation had a notable impact

40

on the board and its senior administrators, and no doubt contributed significantly to the success of their program. Once the support of the board is communicated, the senior administrators carry the banner and the teachers sense the level of commitment, so important to a successful conversion program.

A vital ingredient needed for administrator commitment is awareness of why conversion is being implemented and some knowledge of the content of SI. Some Ministries wisely moved to satisfy this need at an early date. In Western Ontario, for example, the Ministry of Education representative brought together the directors of school boards and their superintendents (equivalent in the U. S. to district superintendents and their immediate subordinates) to an awareness session, shortly after the provincial policy statement was issued. This was followed by a three-day conference involving at least six representatives from each board. The conference was not just for science and mathematics representatives, but rather involved business officers, technical education representatives, and home economics/business education personnel. Patterns such as this occurred in a number of areas in Canada in order to ensure top-level involvement in the planning and implementation of metric education.

This need for senior-level commitment continues throughout the course of the conversion program. It was suggested, for example, that instructions and directives on metric education that go out to the schools be signed by a senior administrator, such as the Supervisor of Programs, rather than by the leader of the Mathematics Resource Group.

Encompassing the Entire School

As noted previously metric conversion (contrary to modern mathematics) affects all areas of the school, not just the classroom. The entire school environment will be impacted by the conversion program and, in turn, what happens in other parts of the school building can help or hinder metric conversion activities in the classroom. Accordingly, it is clear that conversion programs should encompass the total school establishment. Two areas for early involvement should be the physical education program, including competitive sports, and the school library, which can provide an excellent resource for all staff.

The Need for Continuing Communication

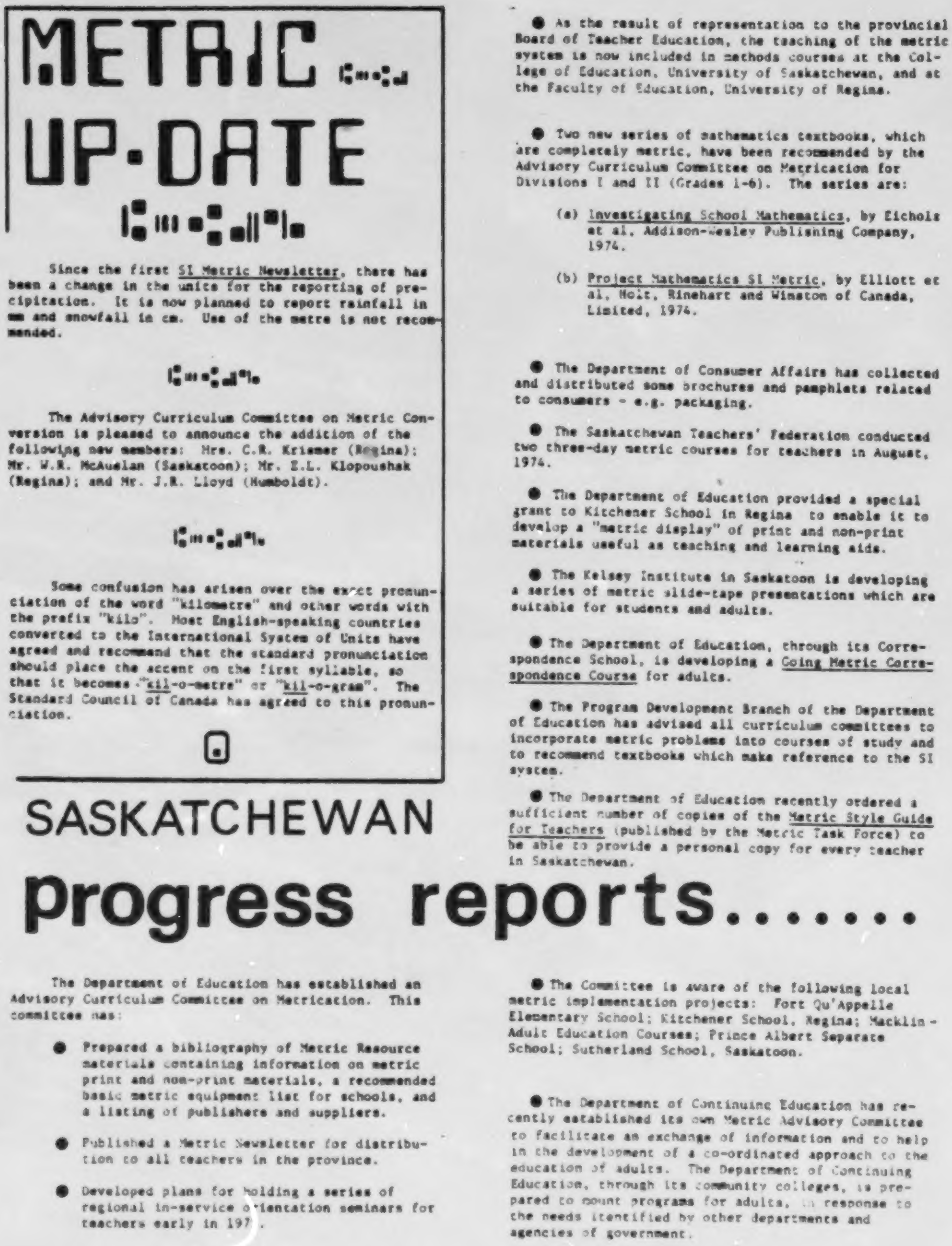
The Metric Newsletter

Hand-in-hand with top-level commitment is the need for clear and continuing communication. Educators at the leading edge of a major national change want desperately to know what is going on not only in their school district but in the community and the nation as well. Regional representatives of the Departments or Ministries of Education, such as those in Ontario, are doing much to satisfy this need through face-to-face contact and through memorandums. But the medium that seems to have gained a particularly high degree of popularity in Canada is the metric newsletter. Examples of this technique were found at the school board level and at both the headquarters and regional offices of the provincial Departments of Education. The diversity of content is best illustrated by the following three pages which were taken from three different newsletters; one produced by a provincial Department of Education, one by a public school board, and one by a regional office of a Ministry of Education.

Another vehicle for satisfying this need is the highly readable Metric Monitor, published monthly by Metric Commission Canada. It is indeed a professional publication; however, its mission is the entire conversion program and its potential audience, the total country. Even with a reported circulation of 160 000, this represents less than 1% of Canada's population of 23 000 000. Obviously, newsletters at the regional and local levels can spread the information from the Commission and, in addition, include important information of direct relevance to educators in a particular area.

Surveys of Metric Progress

In order to satisfy their need to know what is going on among other educators and what is going on in the community at large, some enterprising educators have conducted surveys in their regions. One example of a survey of educators is that conducted by F. N. Pearen of the Ottawa Valley Region of Ontario's Ministry of Education. The highlights of this survey are presented in the following section.



METRIC UP-DATE

Since the first SI Metric Newsletter, there has been a change in the units for the reporting of precipitation. It is now planned to report rainfall in mm and snowfall in cm. Use of the metre is not recommended.

The Advisory Curriculum Committee on Metric Conversion is pleased to announce the addition of the following new members: Mrs. C.R. Kriemer (Regina); Mr. W.R. McAuelan (Saskatoon); Mr. E.L. Klopoushak (Regina); and Mr. J.R. Lloyd (Humboldt).

Some confusion has arisen over the exact pronunciation of the word "kilometre" and other words with the prefix "kilo". Most English-speaking countries converted to the International System of Units have agreed and recommend that the standard pronunciation should place the accent on the first syllable, so that it becomes "kil-o-metre" or "kil-o-gram". The Standard Council of Canada has agreed to this pronunciation.

● As the result of representation to the provincial Board of Teacher Education, the teaching of the metric system is now included in methods courses at the College of Education, University of Saskatchewan, and at the Faculty of Education, University of Regina.

● Two new series of mathematics textbooks, which are completely metric, have been recommended by the Advisory Curriculum Committee on Metrication for Divisions I and II (Grades 1-6). The series are:

(a) Investigating School Mathematics, by Eicholz et al, Addison-Wesley Publishing Company, 1974.

(b) Project Mathematics SI Metric, by Elliott et al, Holt, Rinehart and Winston of Canada, Limited, 1974.

● The Department of Consumer Affairs has collected and distributed some brochures and pamphlets related to consumers - e.g. packaging.

● The Saskatchewan Teachers' Federation conducted two three-day metric courses for teachers in August, 1974.

● The Department of Education provided a special grant to Kitchener School in Regina to enable it to develop a "metric display" of print and non-print materials useful as teaching and learning aids.

● The Kelsey Institute in Saskatoon is developing a series of metric slide-tape presentations which are suitable for students and adults.

● The Department of Education, through its Correspondence School, is developing a Going Metric Correspondence Course for adults.

● The Program Development Branch of the Department of Education has advised all curriculum committees to incorporate metric problems into courses of study and to recommend textbooks which make reference to the SI system.

● The Department of Education recently ordered a sufficient number of copies of the Metric Style Guide for Teachers (published by the Metric Task Force) to be able to provide a personal copy for every teacher in Saskatchewan.

SASKATCHEWAN

progress reports.......

The Department of Education has established an Advisory Curriculum Committee on Metrication. This committee has:

- Prepared a bibliography of Metric Resource materials containing information on metric print and non-print materials, a recommended basic metric equipment list for schools, and a listing of publishers and suppliers.
- Published a Metric Newsletter for distribution to all teachers in the province.
- Developed plans for holding a series of regional in-service orientation seminars for teachers early in 197 .

● The Committee is aware of the following local metric implementation projects: Fort Qu'Appelle Elementary School; Kitchener School, Regina; Macklin - Adult Education Courses; Prince Albert Separate School; Sutherland School, Saskatoon.

● The Department of Continuing Education has recently established its own Metric Advisory Committee to facilitate an exchange of information and to help in the development of a co-ordinated approach to the education of adults. The Department of Continuing Education, through its community colleges, is prepared to mount programs for adults, in response to the needs identified by other departments and agencies of government.

- from "Going Metric," Saskatchewan Department of Education, February 1975a, 1(2)

METRIC TARGET DATES

NOW

1974 - TOOTHPASTE PACKAGED IN SIZES 25mℓ, 50mℓ, 75mℓ, 100mℓ, 150mℓ, 200mℓ.

1975 -

APRIL - TEMPERATURE REPORTS IN CELSIUS ONLY
SEPTEMBER - PRECIPITATION REPORTS IN METRIC UNITS (RAIN IN mm, SNOW IN cm)
AUTUMN - SUGAR TO BE PACKAGED IN METRIC SIZES.

Do you know how to cut this in SI metric units
Gnaw

COMING SOON

1976

JANUARY - NEWSPRINT AND MARKET PULP TO BE SUPPLIED IN SI METRIC UNITS
JANUARY - METRIC SCALES IN THE RETAIL TRADE WILL BE INTRODUCED IN 3 TARGET AREAS
MARCH - PREPACKED FRESH FRUITS AND VEGETABLES TO BE SOLD IN SI METRIC UNITS
MARCH - MOST TOILET GOODS TO BE PACKAGED IN SI METRIC UNITS
SUMMER - THE OLYMPICS, TO BE HELD IN MONTREAL, WILL BE CONDUCTED IN METRIC
SEPTEMBER - ATMOSPHERIC PRESSURE TO BE GIVEN IN METRIC UNITS
SEPTEMBER - THE SHOE INDUSTRY TO CONVERT TO METRIC

1977

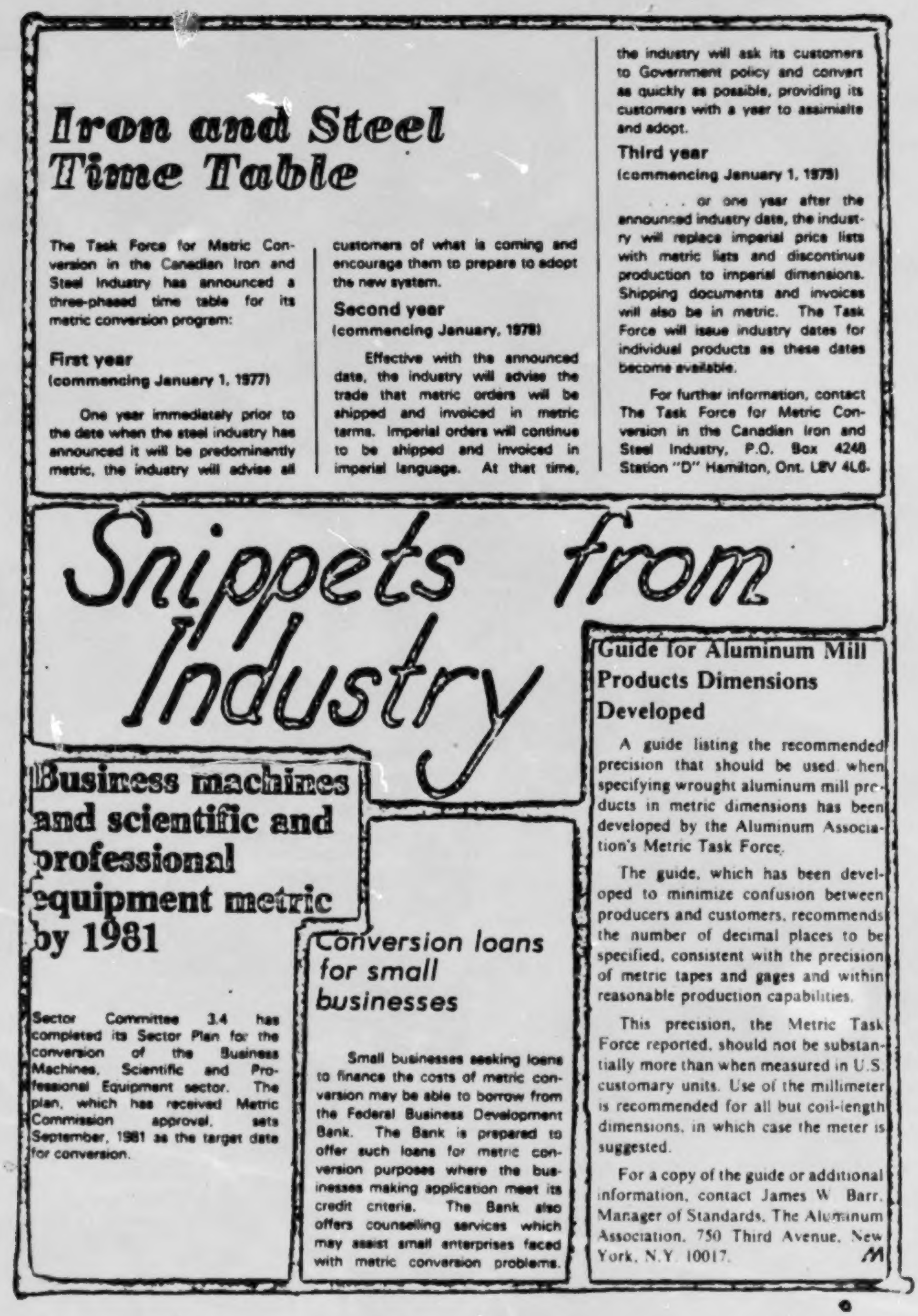
JANUARY - AUTOMOBILE SPEEDOMETERS TO BE MARKED IN km/h
FEBRUARY - ALL GRAIN SALES TO BE CONDUCTED IN METRIC
APRIL - VISIBILITY AND WIND SPEED TO BE GIVEN IN METRIC
MAY - TEXTILE ORDERS TO BE BOOKED IN METRIC
SEPTEMBER - ALL ROAD SIGNS IN CANADA TO BE CONVERTED TO SI
SEPTEMBER - AUTOMOBILE ODOMETERS WILL BE IN KILOMETRES

1979

SEPTEMBER - WOOD PRODUCTS TO BE SOLD IN METRIC UNITS

[THESE TARGET DATES ARE REGARDED AS TENTATIVE AND ARE SUBJECT TO CHANGE.]

- from "Metrigram," Edmonton Public School Board, Metric Communications Committee, Issue 4



Iron and Steel Time Table

The Task Force for Metric Conversion in the Canadian Iron and Steel Industry has announced a three-phased time table for its metric conversion program:

First year
(commencing January 1, 1977)

One year immediately prior to the date when the steel industry has announced it will be predominantly metric, the industry will advise all customers of what is coming and encourage them to prepare to adopt the new system.

Second year
(commencing January, 1978)

Effective with the announced date, the industry will advise the trade that metric orders will be shipped and invoiced in metric terms. Imperial orders will continue to be shipped and invoiced in imperial language. At that time, the industry will ask its customers to Government policy and convert as quickly as possible, providing its customers with a year to assimialte and adopt.

Third year
(commencing January 1, 1979)

. . . or one year after the announced industry date, the industry will replace imperial price lists with metric lists and discontinue production to imperial dimensions. Shipping documents and invoices will also be in metric. The Task Force will issue industry dates for individual products as these dates become available.

For further information, contact The Task Force for Metric Conversion in the Canadian Iron and Steel Industry, P.O. Box 4248 Station "D" Hamilton, Ont. L8V 4L6.

Snippets from Industry

Business machines and scientific and professional equipment metric by 1981

Sector Committee 3.4 has completed its Sector Plan for the conversion of the Business Machines, Scientific and Professional Equipment sector. The plan, which has received Metric Commission approval, sets September, 1981 as the target date for conversion.

Conversion loans for small businesses

Small businesses seeking loans to finance the costs of metric conversion may be able to borrow from the Federal Business Development Bank. The Bank is prepared to offer such loans for metric conversion purposes where the businesses making application meet its credit criteria. The Bank also offers counselling services which may assist small enterprises faced with metric conversion problems.

Guide for Aluminum Mill Products Dimensions Developed

A guide listing the recommended precision that should be used when specifying wrought aluminum mill products in metric dimensions has been developed by the Aluminum Association's Metric Task Force.

The guide, which has been developed to minimize confusion between producers and customers, recommends the number of decimal places to be specified, consistent with the precision of metric tapes and gages and within reasonable production capabilities.

This precision, the Metric Task Force reported, should not be substantially more than when measured in U.S. customary units. Use of the millimeter is recommended for all but coil-length dimensions, in which case the meter is suggested.

For a copy of the guide or additional information, contact James W. Barr, Manager of Standards, The Aluminum Association, 750 Third Avenue, New York, N.Y. 10017.

- from "Western Metric News," Western Ontario Region Ministry of Education, Spring 1977, 3(2)

Ottawa Valley Region metric survey. This survey of all 485 elementary and secondary schools in the Ottawa Valley Region was conducted in the spring of 1977. Over 80% of the questionnaires were completed. Presented below is a summary of the responses which was contained in the September 1977 issue of the newsletter distributed to the schools in the Ottawa Valley by the regional office of Ontario's Ministry of Education.

(a) 90% of the schools in this region will be predominantly metric by June 1978 in line with the Ministry's Policy Statement.

(b) 90% of the teachers are familiar with and using The Metric Guide.

(c) 74% of the schools reported that metric conversion had contributed to pedagogical changes in the teaching [of] measurement.

(d) 99% of the schools are using units and symbols that conform to the International System of Units.

(e) 81% reported that metric conversion is being given a high priority in their schools.

(f) 94% indicated that the conversion of learning materials is being carried out on a pre-planned and gradual basis.

(g) 45% reported that their schools were adequately supplied with metric textbooks, materials and equipment. (The biggest problem here appears to be textbooks according to comments.)

The London, Ontario survey. A survey which provided educators with a feeling of what is going on in business was conducted in 1974 as a joint project by the London, Ontario Chamber of Commerce and the Metric Education Committee for the London Board of Education. To illustrate the types of information obtained, some of the topics covered in the survey are listed below:

- Implications of metric conversion for business
- Number of metric items currently used by business
- Current status of staff training in SI
- Metric units of most concern to business
- Number of metric items currently manufactured and distributed

Authoritative Reference Material

Essential to the proper application of SI in schools is an authoritative reference manual or metric practice guide. Such a guide, in addition to being technically accurate and comprehensive, ideally should be designed in such a way as to invite reading. This latter feature is extremely rare; rather, these reference works are usually less than inspiring both in content and format. Schools throughout Canada have indeed been privileged in having at their disposal a truly outstanding reference document which fully meets these criteria. While it is known to most of the educators we contacted as the Metric Style Guide, it has recently been retitled The Metric Guide (Council of Ministers of Education, Canada, 1976), and made available for sale to the general public. It will be described in Chapter XI, "Exemplary Programs and Materials."

Designing quality reference material, as vital as it is, is not the complete answer, however. The material must be readily available to teachers and furthermore it must actually be used and not just take up shelf space. Distribution of materials is far from a trivial problem, as noted in our study of metric inservice training in England and Australia (Chalupsky, Crawford, Carr, and McDonnell, 1975). In recognition of the importance of providing reference material to all teachers, each provincial Minister of Education purchased enough copies of the Metric Style Guide to supply one to each teacher. The next question was, "How should the Guides be distributed to the teachers?"

According to the experienced metric educators that we contacted, the best method for distributing the Guide was in connection with a workshop. This technique provided an opportunity for teachers to become familiar with its contents, appreciate its value, and gain experience in its use. The hoped-for result was that teachers would continue to use the Guide regularly, both as a technical aid and as a training guide. While we have no direct measure of the extent of the Guide's actual usage, our guess is that this goal was often achieved; for wherever we gathered information we heard praise of its value. For example, when we asked the question "What features of your metric education program have been most important for its success?" the Metric Style Guide was often included as part of the response.

Other Incentives for Teacher Involvement

Teachers play such a critical role in metric conversion programs, and their attitudes have such impact on program effectiveness, that it is understandable why so many of the suggestions we received for improving metric education focused on teachers. Three additional suggestions that merit discussion are:

- Provide released-time for teachers.
- Use tests as an incentive.
- Don't lose your sense of humor.

Providing Released-Time for Teachers

"Most people don't realize the amount of work that is involved with the change." This statement by one of our respondents reflected a general concern that school administrators may not fully understand the strain placed on teachers when they are suddenly faced with learning a whole new language of measurement, abandoning their native language, and then convincing students (and, on many occasions, parents) to do the same.

Acknowledgement of the pressure placed on teachers, and the contribution that teachers are making, was cited as a desirable element in school metric conversion programs. One of the best ways to express this recognition in the eyes of experienced metric educators was to allow time off during the normal working hours to participate in workshops. It was also suggested that teachers could profit from some time devoted to research and outside reading in addition to the time needed specifically to incorporate SI into their curricula.

Using Tests as an Incentive

Knowing that students will be required to understand SI as part of a formal testing program is an obviously potent incentive for teachers to participate in a metric conversion program. The most systematic program in this regard appears to be the examinations required for high school graduation throughout Quebec. By 1977, the examinations for science and mathematics used only SI units, and by June 1978 all examinations are scheduled to be converted, with the exception of those in the vocational areas, which are geared to their respective Sector Plans.

On a smaller scale, a metric coordinator with one of the Ontario Boards of Education noted that the metric awareness test he had administered in September to ninth grade students appeared to serve as a definite incentive for teachers to include SI units in their programs during the year.

Don't Lose Your Sense of Humor

One of the undercurrents that surfaced, off and on during our discussions with metric educators and experienced program administrators, was the recognition of the need for a sense of humor. As important as the mission of metric education is, educators were advised "Don't take yourself and your mission too seriously." "Don't do battle with every little bump or snag that comes along," we were advised, not only as a means of preventing ulcers but also for the benefit of the metric education program.

Judging from the comments we received, many successful educators make a deliberate effort to inject this sense of humor into their teaching programs, especially those for adults, while at the same time being careful to show sensitivity to the legitimate concerns of the public. Test items used in metric awareness sessions can highlight the humor in this new adventure, as shown by the following excerpts from a quiz used by Jack Bell of the Ontario Ministry of Education:

- One one-millionth of a scope is called a (microscope).
- A million telephones is a (megaphone).
- One-tenth of a mate is to (decimate).
- One million million millionth of what a girl loves: (attaboy).

Robert Stevenson, coordinator of the Western Ontario Region of the Ontario Ministry, has also used humor to enliven his training programs, as illustrated by the following item from one of his metric quizzes:

> You have been sent to Hawaii in grateful appreciation for doing your job superbly (or perhaps the inverse). Over the Pacific the captain suddenly says an engine malfunction has slowed the plane and the airspeed is now 180 km/h. Do you
>
> (a) smile and ask for a pillow
> (b) worry because you won't get your connection
> (c) break out in a cold sweat

45/46

VII. IMPACT OF METRIC EDUCATION ON THE TEACHING OF MEASUREMENT

The Need for Restructuring the Measurement Curriculum

The decision to "go metric" in Canada has meant much more to educators than merely substituting a metrestick for a yardstick. Not only has the curriculum needed revision but the methodology of teaching measurement has required restructuring. This need for change has provided educators with the opportunity to evaluate the teaching of measurement principles. Over the years, educators have been concerned that the portion of mathematics programs devoted to the teaching of measurement has been minimal. In 1975, Joan Kirkpatrick, at the University of Alberta, summarized a study conducted by Gunderson which found that only 8% of the total grade 3 program was devoted to measurement. In general, the traditional elementary curriculum has given children relatively little opportunity to become familiar with the measurement process. Instead, much of the measurement instruction has relied heavily upon memorizing tables.

A study by the National Advisory Committee on Mathematical Education (1975) supported the view that traditional school instruction in mathematics over-emphasized facts and skills and tried too frequently to teach by methods stressing rote memory and drill. Even at the elementary level, students were expected to understand measurement by learning such textbook facts as 1 foot = 12 inches. Limited exposure to the actual use of measurement instruments was provided and when students were asked to measure items, it was usually just the one-dimensional and two-dimensional drawings shown in the textbook. The result was that many children did not know how to make and report measurements and they had a limited sense of the relationships among measurement units.

Another characteristic of the traditional curriculum was the lack of distinction between measurement concepts and a measurement system. They were considered the same. Children were taught the concept of length and the unit inch at the same time, rather than being given the opportunity to understand the concept of length prior to being introduced to measuring length with a standard unit.

Canadian educators realize that measurement is an important skill whose development deserves the attention of teachers at all grade levels. Due largely to the work of Piaget (Copeland, 1974; Piaget and Inhelder, 1969), we now have a better idea of how children attain measurement concepts. Piaget's theory of cognitive development describes the developmental stages of children and provides teachers with the opportunity to structure their instructional programs accordingly.

Contingent upon the understanding of measurement is the ability to "conserve." Young children who do not conserve cannot understand measurement because they are unable to accurately compare units of measure. To them, lengths, areas, volumes, and masses change if their shapes are rearranged or altered. According to developmental psychologists, the approximate age levels for the attainment of conservation are as follows (Aho, Barnett, Judd, and Young, 1976):

Ability to Conserve	Years of Age
Length	6-8
Area	6-8
Capacity	8-9
Volume	8-10
Mass	9-10

One must remember that these categories are not absolute. The developmental process will naturally vary from individual to individual.

As children progress through the various stages of development, many problem-solving experiences with manipulative materials should be provided. Sohns and Buffington (1977), relying heavily on the work of Piaget and his colleagues, discuss the four distinct stages in learning to measure:

1. Direct comparison
2. Use of nonstandard units
3. Use of standard units
4. Standard units chosen for specific tasks

In keeping with these principles, the new measurement programs in Canadian schools rely heavily on student activities. Estimating has become a vital part of the program, providing the double benefit of giving children a mental image of the units they are using and the children's estimates in turn inform the teacher how familiar they are with the various units.

The greatest emphasis on metric instruction in Canada has been at the elementary level where the principles of measurement are taught. Typical of the feelings of many of the educators interviewed was the statement, "For the first time, measurement has become integrated into the mathematics program because it is supported by and supports the understandings of our number system." For the elementary teacher, the concepts of tens grouping and decimals can now be shown to have applicability to both numeration and measurement.

At the high school level, the mathematics program typically includes a minimum of measurement topics. Instead, measurement terms are found throughout the mathematics and science programs and students are provided many opportunities to solve problems involving SI units. Although the high school students of today already know the imperial system of measurement, conversion from imperial units to SI units, or the reverse, is discouraged. On the other hand, some teachers do make use of simple comparison of units (e.g., a metre is a little more than a yard) to help their students understand SI units and their interrelationships.

The Place of Decimals and Fractions in the New Curriculum

The fact that SI is decimal in nature has necessitated a re-examination of the fraction and decimal instructional sequence (National Advisory Committee on Mathematical Education, 1975). In Canada, this is leading to an increased emphasis on decimals and a consequent reduction in the use of fractions. Because operations with decimals will be used more frequently than operations with fractions, teachers need to be certain that students understand place value concepts. Smith (1974) has pointed out that the elementary teacher must now not only provide readiness activities for learning the metric system but also consider the students' abilities to understand decimal fractions well enough to change from one unit to another.

Allen (1977b), a well-known Canadian educator, has pointed out that the decimal nature of metric measures focuses attention on important measurement concepts that were formerly overlooked in many school programs. One such concept is the idea that no measurement is exact. With fractional notation the degree of precision of a particular measurement was often obscured. A measurement such as 24-1/2 inches could have been measured to the nearest 1/2-inch or to the nearest 32nd of an inch. Allen suggests that from the start children should be taught that they are measuring something to the nearest centimetre or nearest gram, and that their measurements are not "exact." By using "zero" as a placeholder when writing a measurement such as 62.0 cm, one is also giving the measurement a degree of precision not normally found in the imperial measurement system.

The increased importance of decimals in the mathematics curriculum led educators in Windsor, Ontario to conduct an exploratory study into the learning of decimal numbers. They were most interested in determining the earliest grade level in which decimal numbers could be introduced formally and whether the teaching of common fraction notation would be necessary. The results of their study suggest that grade 3 is the most appropriate level to introduce decimal numbers in a formal fashion (Windsor Roman Catholic Separate School Board, no date).

With the increased emphasis on decimals, the future of fractions in the mathematics curriculum has been questioned (Lindstedt, 1976; Smith, 1974). In general, the conversion to SI is resulting in a reduction in the use of fractions. The simplest fractions, such as 1/2, 1/4, 1/3, are still taught in the primary grades but the teaching of calculations with fractions has been postponed in many schools. A curriculum supplement for teachers in Manitoba (Manitoba Department of Education, 1974) points out that whereas the actual use of fractions will decrease, the main concepts of fractions will still be of great value and continue to be used in other topic areas such as algebraic functions, ratio and proportion, and percentage. Educators interviewed in the programs of Ontario and Saskatchewan also felt that more emphasis is now placed on those fractions having multiples of ten in the denominator.

Alternative Approaches to the Grade Level Sequence

Today, the mathematics curriculum in many, if not most, Canadian elementary schools has been totally converted to the metric system. During the last couple of years, many school boards have issued new Scope and Sequence Charts for Elementary Mathematics. These charts provide an overview of what is to be taught at each grade level. It is expected that, once introduced, the concepts will be reinforced in succeeding years. Table 4 shows the grade levels in which metric units are taught, as summarized from the Scope and Sequence Charts obtained from four school boards and two provincial Departments of Education. An example of a particularly complete chart of metric measurement is presented as Figure 2.

Table 4

ILLUSTRATION OF GRADE LEVELS AT WHICH
CANADIAN SCHOOLS* ARE TEACHING METRIC MEASUREMENT

Topic	Premeasurement Experience**	Standard Units	Interrelationships of Units
	Grade Level:	Grade Level:	Grade Level:
Length	1	2-4	4-6
Area	1-2	3-6	6
Volume	3-4	4-6	6
Capacity	1-2	2-6	5-6
Mass	1-2	2-6	6
Temperature	1	2-4	-

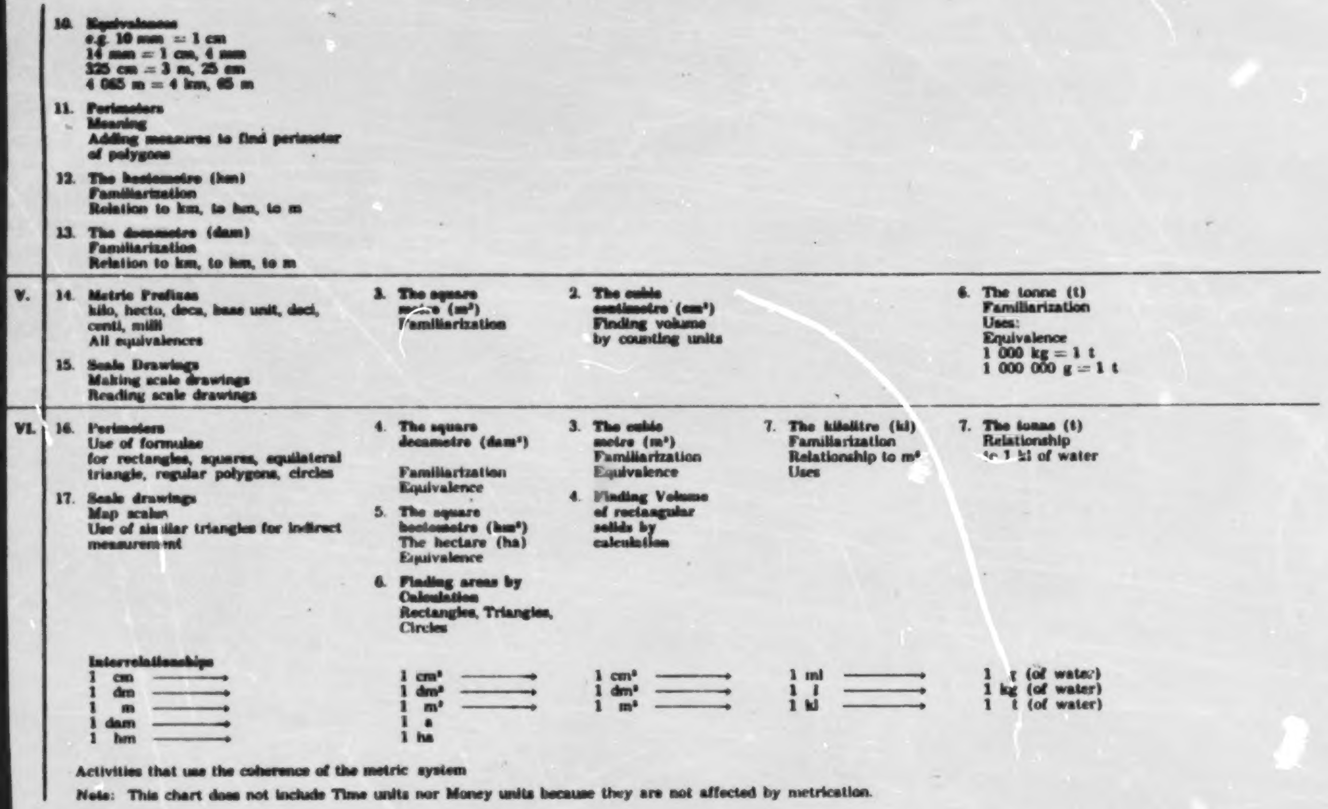
*Based on information from the Alberta and Saskatchewan Departments of Education; two public school boards in Ontario; and two Catholic school boards, one in Ontario and one in Saskatchewan.

**Includes direct comparison and use of nonstandard units.

SCOPE AND SEQUENCE OF METRIC MEASUREMENT

(Based on the tentative outline for elementary mathematics)

GRADE	LENGTH	AREA	VOLUME	CAPACITY	MASS	TEMPERATURE
I.	1. Comparisons Longer-shorter Thinner-thicker Higher-lower 2. Use of non-standard units: footsteps, toothpicks, etc.			1. Comparisons Bigger-smaller More-less 2. Use of non-standard units: bottles, cans, boxes, etc.	1. Comparisons Lighter-heavier	1. Relating the Thermometer to Temperature
II.	3. The centimetre (cm) Familiarization Centimetre rule Measuring to nearer centimetre 4. The metre (m) Familiarization Measuring to nearer metre			3. The litre (*l* or l) Familiarization Measuring in litres	2. The kilogram (kg) Familiarization Measuring mass in kilograms Relationship to 1 *l* of water	2. Celsius Scale Reading thermometer to nearer 10°C
III.	5. The decimetre (dm) Familiarization Decimetre rule Measuring in decimetres and in centimetres 6. First place of decimal Expressing measures using decimal notation: e.g., the length of this page is 2 dm, 8 cm, or 2.8 dm; the width of the room is 8 m, 4 dm, or 8.4 m 7. The kilometre (km) Familiarization Road distances	1. Meaning a. Use of non-standard units b. Counting units to measure area		4. Continued use of measuring in litres	3. Further use of mass to measure in kilograms	
IV.	8. Second place of Decimal Expressing measures using decimal notation, e.g., width of room is 8 m, 4 dm, 2 cm or 8.42 m 9. The millimetre (mm) Familiarization Millimetre rule Measuring in cm and mm, e.g., the width of this page is 21 cm, 6 mm or 21.6 cm	2. The square centimetre (cm^2) Familiarization Measuring area of regions by counting square centimetres	1. Meaning a. Use of non-standard units b. Finding Volume by counting units	5. The millilitre (ml) Familiarization Uses of ml Measuring with ml 6. Equivalent measures 1 000 ml = 1 *l* 3 750 ml = 3 *l*, 750 ml	4. The gram (g) Familiarization Measuring masses in grams. Choosing appropriate mass units for different objects 5. Equivalence 1 000 g = 1 kg 2 580 g = 2 kg. 580 g	4. Temperature referents Freezing water Boiling water Body temperature Seasonal temperatures 5. Reading thermometer to first place of decimal



	10. Equivalences e.g. 10 mm = 1 cm 14 mm = 1 cm, 4 mm 325 cm = 3 m, 25 cm 4 065 m = 4 km, 65 m 11. Perimeters Meaning Adding measures to find perimeter of polygons 12. The hectometre (hm) Familiarization Relation to km, to hm, to m 13. The decametre (dam) Familiarization Relation to km, to hm, to m				
V.	14. Metric Prefixes kilo, hecto, deca, base unit, deci, centi, milli All equivalences 15. Scale Drawings Making scale drawings Reading scale drawings	3. The square metre (m^2) Familiarization	2. The cubic centimetre (cm^3) Finding volume by counting units		6. The tonne (t) Familiarization Uses: Equivalence 1 000 kg = 1 t 1 000 000 g = 1 t
VI.	16. Perimeters Use of formulae for rectangles, squares, equilateral triangle, regular polygons, circles 17. Scale drawings Map scales Use of similar triangles for indirect measurement	4. The square decametre (dam^2) Familiarization Equivalence 5. The square hectometre (hm^2) The hectare (ha) Equivalence 6. Finding areas by Calculation Rectangles, Triangles, Circles	3. The cubic metre (m^3) Familiarization Equivalence 4. Finding Volume of rectangular solids by calculation	7. The kilolitre (kl) Familiarization Relationship to m^3 Uses	7. The tonne (t) Relationship to 1 kl of water
	Interrelationships 1 cm → 1 dm → 1 m → 1 dam → 1 hm →	1 cm^2 → 1 dm^2 → 1 m^2 → 1 a 1 ha	1 cm^3 → 1 dm^3 → 1 m^3 →	1 ml → 1 l → 1 kl →	1 g (of water) 1 kg (of water) 1 t (of water)

Activities that use the coherence of the metric system

Note: This chart does not include Time units nor Money units because they are not affected by metrication.

Figure 2. Example of complete chart of metric measurement (Alberta Department of Education, 1976).

In looking over a number of Scope and Sequence Charts there appears to be a definite trend for decimals to be introduced in grade 3, as compared with grades 5-6 previously. In some schools, students are even adding and subtracting decimals in grade 3. The more usual sequence, though, is to concentrate on place value in the primary grades and begin formal operations with decimals to the tenths place in grade 4. Addition, subtraction, and some multiplication of three-digit decimals is usually emphasized in the fifth grade. By the end of grade 6, students should have a good grasp of decimals to the thousandths place and be able to manipulate them using all four operations.

As discussed earlier, the study of fractions has not been eliminated as a result of conversion; students are still being introduced to simple fractions in grades 1 and 2. Operations with fractions are still taught but the grade levels for this work now vary. In some schools, students continue to learn to add and subtract like fractions in grades 5 and 6. In others, the manipulation of fractions has been postponed to grades 7 and 8. A number of school boards in Canada have not yet developed a formal policy on the teaching of fractions and decimals. Prince Edward Island, for example, hopes to cut way down on the teaching of fraction operations and shift what is taught to higher grade levels. Contributing to the problem has been the fact that many textbooks were slow to be changed, and some were changed several times. According to an educator in Ontario, one mathematics series has had three different editions in three years. (It was noted that many teachers rely heavily on the text to teach mathematics, and the idea of modifying the textbook approach is unthinkable.)

A discussion of textbook and other problems is presented next.

VIII. SOME PROBLEMS FACED IN METRIC EDUCATION

No program as complex as metric conversion can be free of problems. And yet, metric education in Canada does appear to be free of crippling problems. (This same statement could very likely be made about the entire conversion program in Canada.) Nevertheless, during the course of our interviews, as well as in our follow-up survey, we attempted to uncover problem areas that could serve as a warning to educators with only "one toe in the SI mainstream." The problems we identified can be grouped in the following categories:

- Educational Materials, Texts and Tests
- Administrative Inertia
- Teacher Hesitancy
- Problems with Specific Grades and Subjects

Educational Materials, Texts and Tests

Metric Training Aids

The serious lack of high quality teaching aids appears to have been remedied in large measure, and the situation continues to improve. According to several observers, the "junk which appeared early has pretty much disappeared because of poor quality. People are becoming more discriminating." Of course, the task of identifying training aids with proper SI notation has been facilitated greatly by the National Symbol for Metric Conversion, which is available for labelling materials which meet the appropriate SI standards. The Symbol and its use will be discussed in detail in Chapter XII.

According to our respondents, metric equipment and material problems have centered in three areas: inappropriate specifications, cost, and poor quality control. Many suppliers are not sensitive to the learning needs of children and the specifications on their measuring instruments are not always appropriate. Sometimes, metric materials are unrealistically priced, and suppliers try to take advantage of specific demand. Quality control, particularly on wood products, can be a problem; while some equipment, for example, mass scales, are unable to withstand the strain from young hands.

Texts and Tests

In earlier years especially, the lack of quality textbooks using SI was of serious concern. Individual provinces, with relatively small numbers of students, found that they were unable to pressure publishers to produce the types of texts desired, at the time required. This problem apparently persists today in the social sciences, with geography being specifically singled out as a trouble-spot. Home economics texts and chemistry texts were also cited as problem areas. The difficulties with chemistry texts can be rather subtle and difficult to communicate to authors and publishers because these texts are often based on an earlier metric system and are not SI.

Another source of irritation to metric educators in Canada has been the delay in the availability of advanced texts, such as medicine and engineering, many of which are imported from the United States.

The problem of standardized tests using imperial units was raised during the course of our interviews, but apparently it has not been viewed as a critical issue. (Quebec, for example, has its own provincial test development program.) This problem may very well be a source of greater concern to U. S. educators because of their heavier use of commercial tests.

Administrative Inertia

One of the problems faced, particularly at the early stages of conversion, was the inertia of some of the administrators. A lack of commitment on their part can have a serious impact on the implementation activities of teachers, according to the metric experts that we contacted. Accordingly, the leaders in metric education have felt the need to reach administrators, particularly at the senior level, and make certain that they understood the priority assigned to metric education and realized that conversion should be accomplished in stages and not as a "crash program."

At the postsecondary level, problems arise because of the increased autonomy of these institutions and, at the university level especially, the independence of the various departments and professors. Nevertheless, as mentioned by one college instructor, the typical staff member is not anxious to oppose the wishes of the college president. "If they don't know whether the president is for or against the change, the safest role to play is to be passive and not show your hand."

Even though metric coordinators are supposed to monitor progress in each college, oftentimes these coordinators have many other duties. Ideally, a full-time coordinator should be assigned, but it was recognized that funds for this purpose are just not available in most colleges.

Teacher Hesitancy

The reluctance of some teachers to "accept the inevitable" was an issue that came as no surprise to experienced staff of the provincial departments of education who are often faced with introducing curriculum reform. The voluntary nature of metric conversion prompted resistance, or at least indifference, as indicated by the following comment: "We know we should but we don't want to." There was a feeling on the part of some highly motivated staff that more pressure should have been exerted by the provincial Ministers of Education and, in turn, by the individual school boards.

A more subtle solution to the general problem of resistance was posed as follows: "Get something off the ground and do it well, with good public relations." An example of a particularly influential event was the conversion of temperature to degrees Celsius in Canada. This paved the way to further conversions of a more complex nature. According to one of our respondents, an example of how not to proceed was the "highway sign fiasco" in the United States, where the Federal Highway Administration (FHWA) proposed a program for conversion of highway signs in three months during 1978; then, in less than a month, changed its plans to conversion during an 18-month period in 1978 and 1979; and finally, one month later, announced the withdrawal of the proposal. The major reason given for withdrawal was the fact that of the 5000 letters received by FHWA on this issue, over 90% were against the change.

Problems with Specific Grades and Subjects

In addition to exploring the general problems associated with metric conversion, project staff attempted to identify conversion problems associated with specific grades and subject areas. The four areas of special difficulty were identified as:

- University level
- Science
- Nonmeasurement subjects
- Technical/Industrial arts

University Level

Among the different levels of education in Canada the one that appears to be moving the slowest toward conversion is the university. This lack of momentum has been attributed, at least in part, to the atmosphere of academic freedom that pervades the campus. However, it was also acknowledged that various professional fields have been reluctant to play a strong leadership role in providing the correct technical information. Another possible explanation is that experienced professors, even though they know the corect SI units, are hesitant to attempt to master the new measurement language since so much of their expertise in knowing various "benchmarks" disappears during the learning stage.

One respondent indicated that enthusiastic university administrators can do much to increase the student awareness of metric conversion by initiating programs such as the following:

- Installing metric speed limit signs in the university parking lot
- Inserting metric awareness material in the campus newspaper
- Sponsoring a "know your mass and measurements in metric" week

Science

Science teachers at every level face their own problems during the conversion period--much like the university professors just cited. As mentioned before, textbooks in many areas of science have just not kept pace with the conversion program, while a goodly number of science instructors feel they already are expert in the metric system. What many do not realize--or do not care to admit--is that the metric system they know is now obsolete in a number of areas. Impressing on this group that it is important to study SI is indeed a "sticky challenge."

The subject area of science provides one of the greatest opportunities for using SI units. Our respondents pointed out that because many of the concepts taught in secondary school science are new to students, there is an obvious advantage to teaching proper SI from the beginning. For example, when the student learns about pressure, it makes no difference to him/her if it is measured in atmospheres or pascals. The main effect going metric has had on the science courses is really just the substitution of SI terms for outdated terms.

Nonmeasurement Subjects

The initial emphasis on metric conversion was directed, understandably, toward the subjects of mathematics and science. The textbooks in the social studies areas, language arts, etc., have been slow to change. As a result, many teachers of these subjects have tended to feel that SI does not apply to them. This problem appears to be more serious at the secondary and higher levels than at the elementary level, perhaps because the typical elementary teacher is often responsible for mathematics and/or science in addition to one or more nonmeasurement subjects.

Teachers have found that physical education courses provide an excellent laboratory for converting to the metric system of measurement. In most cases, the cost of metric equipment has been minimal (metresticks, tape measures, scales). Track events in Edmonton were converted in 1973 by simply moving the finish line and measuring with metric units. Volleyball courts just needed new lines painted. On the other hand, in order to convert other sports, such as swimming, significant changes in equipment and facilities have been required.

Because the social studies curriculum relies on many resource materials (atlases, films, encyclopedias, etc.), it will be many years before this subject area is completely metric. Rather than wait for new texts before using metric measurement, social studies classes in the Edmonton school system were reviewed and a list of conversions for each grade level was compiled. These lists have been available to teachers on a request basis since fall 1975.

The lack of suitable textbooks in some curriculum areas has not deterred the teacher who is concerned about keeping in step with SI progress. Supplemental materials have been obtained or corrections to the text have been prepared by these teachers.

Technical/Industrial Arts

Conversion in the industrial or vocational education areas shares many of the problems common to other subjects but, in addition, contains some unique problems such as machinery conversion costs and the need to keep in contact with industrial changes. As a result, some metric coordinators, faced with considerable resistance from directors of technical subject areas, have made special attempts to keep updated on industrial changes and the availability of metric guides and instructional publications.

Before major changes are made in the industrial arts program, it is vital that a careful study be made to determine what equipment needs to be replaced immediately, what equipment can be modified, and what should be retained "as is" until normal replacement is necessary. A description of an exemplary study of school shops is contained in Chapter XI.

The lack of suitable metric textbooks in the technical area, as well as in home economics, has deterred many teachers who rely heavily on the textbook. Efforts have been made to assist instructors in updating their curriculum materials to reflect proper SI. An excellent example is the work of L. W. Turner (1976), at the Northern Alberta Institute of Technology (NAIT). In a paper directed at NAIT staff, Turner states that conversion to SI units for a course of instruction essentially consists of:

-identification of measurement/unit sensitive statements/ elements in present course material,

-obtaining lists of approved SI units from technology/ trade,

> -modification of course literature/equipment to comply with SI practice.
>
> The identification phase is now urgent. May I suggest that henceforth on completion of each lesson you spend a few minutes to read and circle all statements containing imperial units (or outdated metric units) in your lesson plan.
>
> By applying a similar procedure to printed matter and visual aids used in the lesson and, making notes of revisions required, you will complete the identification phase as each course is taught. (p.1)

Following the identification phase, Turner advises a program for revising course materials, including the following points:

> (a) Try to avoid soft conversions for your new SI lesson material.
>
> (b) If dual-units are used, ensure all instructors in program are using same format.
>
> (c) Take extra care in writing your manuscripts, to avoid typing errors. Be persistent about having errors reworked.
>
> (d) Try to have your new material screened by someone for correct usage of the SI.
>
> (e) Double check all work before bulk printing handouts. (pp.2-3)

A down-to-earth discussion by Turner of how to avoid embarrassing classroom situations during early presentations using SI units is presented in Appendix C.

IX. EDUCATING PARENTS AND THE COMMUNITY IN SI

The Need for Parental Support

The "top level" in any school organization is, or should be, the parents. Without their support the best designed programs can crumble. The crucial nature of parental support was reflected in the attention that some of the school board representatives devoted to this problem. In Middlesex County, Ontario, as an illustration, every school had at least one hands-on session for parents during 1974. One novel idea in the London, Ontario area was to bring teachers and parents together for initial awareness training. Besides helping to orient both groups, these sessions strengthened the bonds between parents and teachers. Another technique for educating and involving parents is the use of handout materials taken home by the children. An attractive example of this is the "Hey! Mom and Dad" series distributed by the Edmonton Public Schools. A copy of one handout is presented on the following page.

Educating parents at an early stage of conversion clears up many misconceptions about the overall conversion program. Specifically, it counteracts the impression of some parents that the school is the reason the country is going metric. In addition to gaining parental support for metric school activities, educational programs for parents provide a major contribution toward educating the general public. In actual fact, it appears that reaching the adults through PTA or other school-sponsored programs can result in a much better turnout of adults than adult education courses generally. Furthermore, those adults that do attend have a clear reason (their children) for understanding and supporting the conversion program and for learning SI.

Involvement of parents and community leaders is also certain to result if these persons are included on metric committees. The London, Ontario metric committee, in addition to representatives from all major education departments, included individuals representing the University of Western Ontario, the Chamber of Commerce, the Teachers' Federation, and a major industry.

MOM and DAD

HELP YOUR CHILD — HELP YOURSELF

Weather is Metric

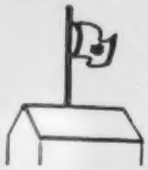
Temperature IN Celsius °C
Rain IN millimetres mm
Snow IN centimetres cm

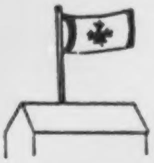
AND NOW---

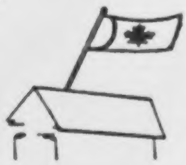
Wind Speed IN kilometres per hour km/h

WIND SPEED BENCHMARKS

Descriptive Term	Speed Range in km/h	Effect
light winds	20 and under	Wind felt on face; wind extends light flag, leaves rustle and move
moderate winds	21 to 40	Raises dust and loose paper; crested wavelets form on inland waters; fine loose snow begins to drift.
strong winds	41 to 60	Large branches in motion; whistling heard in telegraph wires; umbrellas used with difficulty; extensive drifting snow; inconvenience felt in walking against wind.
gale winds	61 to 90	Breaks twigs off trees; walking made difficult; slight structural damage occurs, e.g. to roofing shingles, TV antennae, etc., blowing snow reduces visibility
storm force winds	91 to 115	Trees uprooted; serious structural damage occurs; driving made difficult
hurricane force winds	over 115	Accompanied by wide-spread damage (occurs infrequently in Canada)







Reaching Out to the Community

Some Views of School Representatives

To what extent schools should take a lead role in community education (other than via parent programs) is open to question, based on the results of our Canadian survey. One feeling is that the job of educating parents is so big that going beyond this audience should be left to others. In addition, it was noted that several attempts by school personnel to provide general adult courses met with cool reception.

Nevertheless, some leaders in metric education strongly maintain that schools should take a leading role in educating the community. Such efforts, it was claimed, provide an excellent vehicle for improving public relations and, in addition, have a positive effect on the staff. Various community groups, ranging from the Chamber of Commerce to "Weight Watchers," have benefited by programs presented by metric educators.

In Saskatchewan, the schools have received many compliments for the community leadership they have shown. One strategy that was used was to ask for donations from adults according to what they thought the workshop was worth. A real success story to cheer the hearts of educators was the case where $800 was donated from a community having a total population of 300.

How Can Community Education Be Improved?

Recognizing that community support is a vital part of an effective metric conversion program, representatives from the Consumers' Association of Canada (CAC) were contacted for recommendations on community education. The CAC is an organization with a membership across Canada approaching 100 000. It has officially gone on record in support of metric conversion, emphasizing its potential benefits to the consumer. At the same time, it recognizes that problems can arise and in the April 1976 issue of its monthly publication, Canadian Consumer, urged members to let their concerns be known to industry. In this issue, some 24 pages were devoted to an attractive display of metric information for everyday use. This insert has been issued as a separate publication and has also been adapted for distribution in the U. S. by Consumers Union of United States, Inc. (1977).

To obtain a range of consumer viewpoints, six metric coordinators located in six different provinces were contacted. The rich variety of suggestions obtained clearly indicates the value of involving a cross-section of active consumer representatives in metric education plans.

Taken in toto, the recommendations point up the need for an information saturation campaign encompassing the following:

- Displays and demonstrations
- New product fan-fare
- Increased media coverage
- Handout literature
- Information centers
- Short courses

Displays and demonstrations. According to the CAC representatives, consumers need practical, simple information and every opportunity should be taken to provide it. Especially effective display booths can be set up in shopping malls, for example, while individual stores might well consider establishing a "metric corner" where literature and even demonstrations can be provided. In the words of one consumer representative,

> The thing I found most was that people feared the unknown--in this case metric conversion--and what they fear, they are against. Because people knew so little of how the change would affect them, there was a strong negativism from the start. I think there should have been a bombardment of information to overcome the lack of knowledge of what it would mean in their lives--the practical application as far as John Q. Public is concerned.

New product fan-fare. Products that are "hard converted," i.e., packed in round metric sizes, should be introduced with a certain flair, and accompanied by simple, attractive point-of-sale information. If done in this manner, say the consumer experts, the general public can develop confidence that they are not being "ripped off." In Canada, it was learned that one of the activities of CAC members was to contact retailers to discuss point-of-sale information and to make suggestions concerning what type of information should be provided to consumers.

Increased media coverage. Media support was viewed as a crucial element in community metric education. But the concern was expressed that media representatives must be very well informed and, ideally, should coordinate their changeover to SI on a community-wide basis to minimize public confusion. Representatives of CAC have supported a wide range of media activities, including authoring, or serving as resources for, newspaper columns and participating in many TV and radio talk shows.

Handout literature. There was no question that Metric Commission Canada produced an abundance of attractive brochures and other educational materials. The only concern voiced was that such material often did not get to a sufficient number of consumers. Accordingly, it was mentioned frequently that consumer representatives could perform a valuable service by disseminating such information at every possible opportunity. Members of CAC did in fact serve this function by providing handout information at bazaars, fairs, libraries, and shopping malls.

Information centers. According to our consumer experts, one particularly valuable strategy for disseminating information to the general public would be to establish information centers where materials could be handed out and questions answered. These centers could help prevent the types of problems described by one respondent:

> My husband...attempted to obtain specific information on how the change would affect the individual trades. All the Metric Commission sent was general information. He was frustrated. There has to be easy access to needed information.
>
> Australia went [metric] earlier and a man called me who works at [an] International Airport and occasionally worked at fueling airplanes. He didn't know where to get information for fueling Qantas planes. I called the Metric Commission--they said he should write to Australia--scary, isn't it!

Short courses. One of the problems of adult education courses cited was that they are often too technical, attempt to cover too broad an area, and last too long. A consequence of this is that the average person goes away feeling the change is worse than expected. To avoid this, it was suggested that brief mini-courses might be designed to cover specific topics such as sewing, home carpentry, or gardening. One type of training that was cited as having significant consumer impact is a short course for retail store clerks. The CAC representatives responding to our survey noted that they have participated in workshops for groups ranging from senior citizens' organizations to individual school and teacher groups.

Recommendations for Improving Cooperation Between Schools and the Community

While many suggestions were obtained from consumer representatives for improving school-community cooperation, these suggestions seemed to focus primarily on involving children in the education of parents and other adults. In this respect, their suggestions resemble the strategies employed by Australian educators, as noted in our initial study (Chalupsky, Crawford, and Carr, 1974, p.82).

Examples of the suggestions received from our Canadian survey are quoted below:

- The children could certainly be an instrument for taking home much needed information. Material should be practical--not mathematical!
- Children should be encouraged to "talk metric" with their parents.
- Children could design some "helps" for parents and others, e.g., those in old folks homes. They might enjoy a "metric skit," some metric songs, and some posters.
- Children could be involved in preparing local television shows on metric.
- Children could bring parents along to a workshop and work together.
- School sports days could be used as a metric learning experience for both children and parents.
- School "open house" days could have metric displays for parents, and the rest of the community could also be invited.
- People involved in school metric programs could submit short articles to community newspapers--great vehicles for metric education!
- Schools should invite media representatives to talk with teachers and students about their metric education programs.

X. MEDIA AND METRIC EDUCATION

The metric conversion program has received considerable coverage by the media, due in part to the material produced by the Metric Commission and to the fact that major aspects of the program, notably weather reporting and highway signs, have directly affected the lives of all Canadians. Since 1975, metric conversion in Canada, like it or not, has been news.

The Use of Films, Television and Radio

Both the National Film Board (NFB) and the Metric Commission have produced major films dealing with metric conversion. Two NFB films, "Ten the Magic Number" and "The Decision," had received wide exposure across Canada by 1975. During the 1976-77 fiscal year, the Metric Commission produced 25 sponsorable public programs for distribution to AM and FM radio stations, one public affairs information show, and two television specials. One of the television specials received a Gold Medal at the 20th International Film and Television Festival in New York City, where it was rated in the top 8 out of 1000 entries.

A particularly popular format has been the open-line radio and TV program. The Commissioners and the staff of Metric Commission Canada have often appeared as guests to answer questions. One of the most active Canadians in this regard is not associated with the Commission but rather is an educator at the Nova Scotia Teachers College, Dr. H. D. Allen. Over the years, Dr. Allen has responded thoughtfully and frankly to the concerns voiced by many Canadians in the Atlantic provinces. These hot-line experiences have led to the development of two series of 55-second radio spots, called "Metric Moments," using the question and answer format. Each cut features a brief metric question from the Program Director of Radio Station CKCL, Truro, Nova Scotia, followed by an answer from Dr. Allen. The first series was used by some 90 stations across Canada, while the second series of 30 programs was just announced during June 1977. The master tapes of the programs were produced as a public service by CKCL and copies are being furnished to individual stations by the Canadian Association of Broadcasters for a very small service charge.

77

The types of questions included in the interviews are illustrated by the following examples (Nova Scotia Teachers College, 1977):

Q. We hear metric units spoken of in a number of ways. Are there preferred names and pronunciations for those units likely to be in common use?

Q. What real advantage is there to "metric" on the highways -- distances in kilometres; speed limits, kilometres per hour?

Q. With use of metric increasing in so many countries, including Canada, what exactly has been happening in the United States?

Providing other radio stations across Canada with "Metric Moments" is not the only metric achievement of Station CKCL. Several years ago, the station arranged a meeting of sponsors and invited the Metric Commission to give a presentation. The crowning achievement came in 1975 when CKCL held a contest to guess the distance in kilometres from Truro to St. Petersburg, Florida. This was a call-in contest with eight calls accepted per day over a period of two weeks. With a prize value of approximately $1400 (roundtrip for two plus one week's stay in St. Petersburg), the contest was so successful that the volume of phone calls actually disabled some of the community telephone circuits.

The contest brought CKCL an award for the most unique contest from the North American Broadcasters' Association and the station may well be the leading radio station in metric promotion across Canada, thanks to a public spirited Program Director and to a motivated metric educator.

An apparently successful venture of metric education via TV is the program "Report Metric," featured by TV Ontario. The five-minute show, aimed at students in grades 4-6, is broadcast twice daily, Monday through Friday. The cartoon show encourages children to send in their own adventure stories, consumer reports, and songs for reading on future programs. According to the December 14, 1977 issue of the Toronto Star, "Report Metric" is the educational channel's second most popular children's program, receiving some nine kilograms (nearly 20 lbs.) of mail each week. According to the producer, the four-year-old show should complete its task this season.

Newspaper Involvement

For several years now, Canadian newspapers have had a growing share of metric articles, especially during the periods of metric weather reporting and highway sign changes. Conversion has been the subject not only of news articles but of feature stories and letters to the editor, as well. Many of these articles have been humorous attacks on the conversion program. The topic of metric measurement now appears to be expanding beyond the news and humor columns with an effort on the part of newspapers to truly educate their readers on the metric system. One illustration of this is the popular syndicated column entitled "Metric Facts," by Professor Lee Hutton of the McGill University Faculty of Education. "Metric Facts" is presently carried by 11 newspapers, representing some of the larger cities in Canada. The column's mission is both to educate readers on specific metric usage and to inform them on important events in the metric conversion program. While the content is serious in tone, the theme of each article is illustrated by a clever cartoon.

Observations on Media Involvement

In a recent column of the November 25, 1977 issue of the Edmonton Journal, Hutton stressed the important role of media in aiding the progress of metric conversion. While recognizing that kilograms and kilometres are being used frequently in Canadian newspapers, with rarely a reference to Fahrenheit, Hutton appealed for sympathetic understanding of the reader for the occasional errors or discrepancies that arise. He also defended the caution with which the media have approached the issue of conversion, attempting "to tread the fine line between moving too fast or dragging behind." While editors and station managers are very aware of their public service role, "the newspapers must sell, and the TV and radio stations must hold their listeners."

One possible illustration of the attempt to hold readers is the clever columnist's humorous attack on the conversion program; a rather common occurrence, as noted previously. Despite concerted efforts by Metric Commission Canada at media relations, media seminars, and a freelancers' bureau, very few feature articles in Canadian newspapers can be labelled pro-metric. During the months of September and October 1977, some 25 feature stories or commentaries on metric conversion were noted in six papers from the cities of Edmonton. Toronto, Ottawa, Vancouver, Saskatoon, and Halifax. Of these, 2 were positive, 10 could be considered as fairly objective (and/or at least resigned to Canada's metric conversion), 7 were obviously anti-metric (or protesting conversion in Canada), and 6 of the articles examined presented metrics in such a humorous light that it was difficult to determine whether it would help or hinder the conversion effort. As Allen (1977a) has noted, "Metric conversion, even well done, is not the sort of program that wins votes. Opposing it sometimes can"(p.2). In this respect, perhaps columnists bear some similarity to politicians in their views of the popular appeal in opposing conversion.

An in-depth study of the role of media in metric education was not possible with the resources available in the present study. The information that was obtained, however, suggests that a specific analysis of Canada's successes--as well as its problems--with media may save the U. S. a great deal in cost, emotional as well as financial.

XI. EXEMPLARY PROGRAMS AND MATERIALS

Introduction

In any innovative program of the magnitude of metric education, one finds programs or products which attract attention because of their unique nature or apparent success. While it was beyond the scope of this study to do an exhaustive search, we did nevertheless identify several exemplary achievements which merit further review. Recognizing that there are no doubt many other Canadian programs and products that could be considered exemplary, the following are presented in this chapter as examples of noteworthy metric education efforts:

- The Metric Guide
- Calgary Board of Education Metric Project
- Nova Scotia Teachers' College SI Metric Resource Kit
- Converting to SI in Ontario School Shops
- Publications of Metric Commission Canada

The Metric Guide

The Metric Guide (Council of Ministers of Education, Canada, 1976) cited in Chapter VI, is an excellent example of a definitive reference volume that is most appealing to the reader due to its writing style, its abundance of examples, and its imaginative illustrations.

The Metric Style Guide, as it was originally titled, was prepared by the Metric Task Force of the Council of Ministers of Education in 1974. The Task Force was chaired by Jack Bell of the Ontario Ministry of Education and consisted of representatives from Alberta, British Columbia, Nova Scotia, and Quebec. While the preparation of the Guide was supported by the Council of Ministers of Education (representing the provincial Ministries or departments of education), some financial assistance was also provided by the Metric Commission. The Guide is an official document of the Council and carries the approval of the Metric Commission, as signified by the National Symbol for Metric Conversion. Nevertheless, its use within each province is at the discretion of the provincial department of education, as indicated in the Introduction:

> While the Council of Ministers of Education hopes that this guide will provide a measure of uniformity across Canada with respect to metric terminology and symbolism, the Council also emphasizes that each province is responsible and free to implement the contents of this document in the curriculum of the schools in any manner deemed appropriate.

The contents of The Metric Guide are presented in six chapters:

- Chapters 1 and 2 cover the familiar five basics: length, volume, mass, time, and temperature.
- Chapter 3 presents basic rules of style and is a valuable reference for students, typists, and business office personnel.
- Chapters 4 and 5 present material most useful to people involved with science, technology, and technical specifications. Lucid explanations, however, make these chapters useful, as well, for the layman.
- Chapter 6 contains conversion tables, definitions, and terminology.

The Metric Guide also contains a very comprehensive index.

Complementing the interesting style of the basic text are many marginal notes which challenge the reader with questions or provide fascinating background material such as the following:

> At one time, there was a very slight difference between the cubic decimetre and the litre, or between any two corresponding cubic and capacity units--only 28 parts in 1 000 000--not enough to concern most people. In 1964, this small difference was removed and the litre is now defined as exactly one cubic decimetre. (p.161)

With this abundance of examples and illustrations, it is undoubtedly the most attractive and interesting document of its kind. In recognition of its visual excellence, it was chosen as one of the "Fifty Books of the Year, 1975" by the American Institute of Graphic Arts. It was originally intended "solely to give teachers information on the terminology and symbolism to be used as Canada adopts the modernized metric system known as SI"; the name change reflects its recognized potential as a self-teaching tool for general use. Fortunately, the Guide is now available for sale.* It deserves the attention of all metric educators in the United States and Canada. NOTE: a caution is needed for U.S. readers--imperial units of capacity, such as quarts and gallons, differ from U.S. units.

Calgary Board of Education Metric Project

Leonard J. Hall began a three-year appointment as metric coordinator for the Calgary Public School System in September 1974. "During the first year of this assignment he has made an auspicious impact upon metrication in Calgary....It is a model approach to the job of metricating a large urban school system" (Alberta Department of Education, 1975).

The Calgary Board of Education Metric Project was completed at the end of the 1977 school year. A history of the implementation of the project and its achievements is presented next.

Feasibility Study

In October 1973, the Calgary Board of Education, recognizing the imminence of metric conversion in Canada, set up a committee to make recommendations as to the most feasible way to introduce the metric system as a working operation into the school system. The committee was composed of teachers of mathematics, science, social studies, home economics, technical-vocational, and physical education; one administrator, one representative of the Alberta Teachers Association, and one trustee.

In March 1974, the "Report of the Metric Feasibility Study" was presented to the Calgary Board of Education. Eight recommendations were made in this report:

1. That a coordinator be appointed for a period of three years.
2. That a steering committee composed of teachers and administrators be established.

---

*Distributed by the Ontario Institute For Studies in Education, 252 Bloor Street West, Toronto, Ontario M5S 1V6.

3. That a system-wide teacher preparation program be implemented.
4. That the metric units (SI) be introduced as an independent system.
5. All equipment and supplies, print and non-print, ordered be metric, where feasible and possible.
6. A public relations program be implemented and all communications be of the "low-key" type. The individual schools share (with the coordinator) the responsibility to inform their communities of their programs of metric changeover.
7. That three stages of implementation be adopted:
    (1) preparation of teachers and development of materials
    (2) implementation in the classroom
    (3) total conversion
8. That the sum of $95 825 be allocated in the four budget years 1974 through 1977. (Final expenditure was $127 949)

Implementation of Recommendations

The Board of Education in September 1974, acting on Recommendation 1, appointed Hall as the full-time metric coordinator for the Calgary Public School System. Twelve members of the system plus a trustee were chosen to serve on the "Metric Steering Committee." At its first meeting, the Steering Committee approved the Organizational Chart, included as Figure 3.

Major Areas of Activity

The three-year Calgary program was divided into five major areas of activity:

- Teacher preparation
- Development of curriculum materials
- Parent workshop program
- Non-teaching workshop program
- Information dissemination and other services

Teacher preparation. A team of ten regular classroom teachers developed a full-day introductory workshop for teachers. The development activities were done in a period of five consecutive days. Due to the demand for workshops, five additional workshop leaders were trained at a later date.

A vacant classroom in each of five city areas was transformed into a metric workshop laboratory. School staff were encouraged to attend a work-

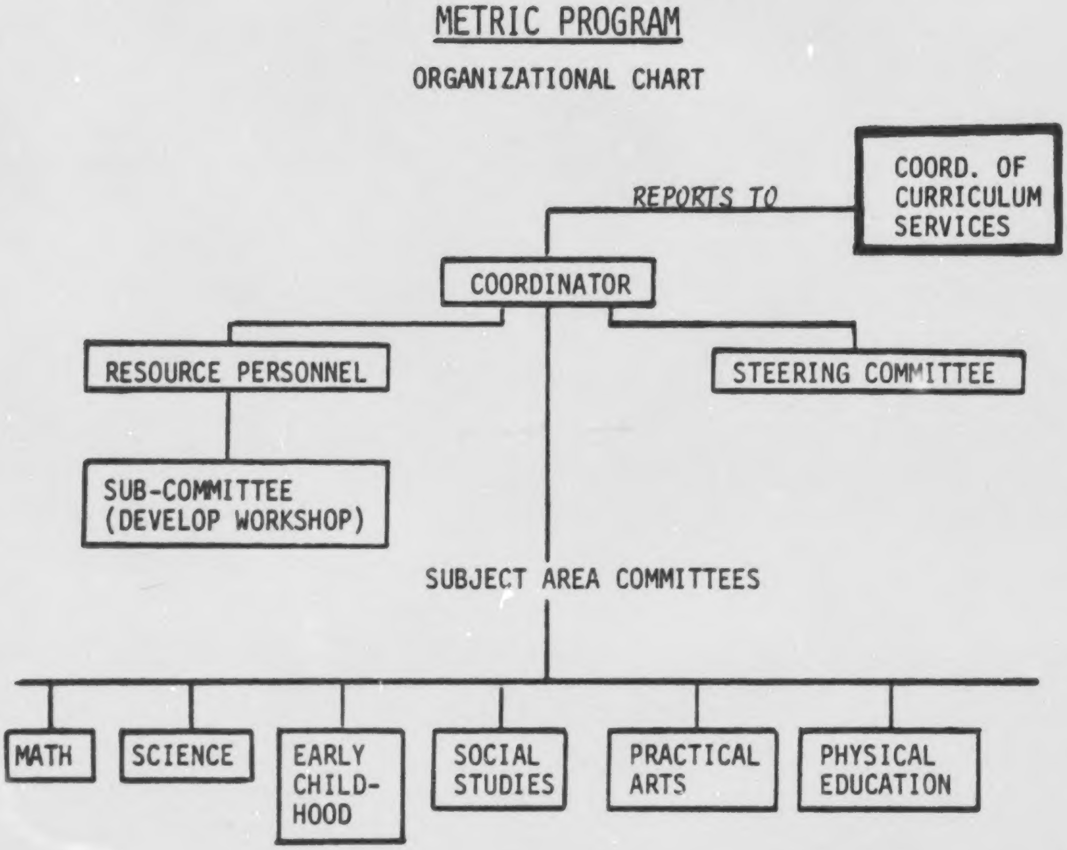

METRIC PROGRAM
ORGANIZATIONAL CHART
COORD. OF CURRICULUM SERVICES
REPORTS TO
COORDINATOR
RESOURCE PERSONNEL
STEERING COMMITTEE
SUB-COMMITTEE (DEVELOP WORKSHOP)
SUBJECT AREA COMMITTEES
MATH
SCIENCE
EARLY CHILD-HOOD
SOCIAL STUDIES
PRACTICAL ARTS
PHYSICAL EDUCATION

Figure 3. Organization chart of the Calgary Board of Education Metric Project. (Hall, 1977, p.5)

shop on a professional development day. Funds from the Metric Project were provided to pay classroom substitutes for the workshop leaders. Staff members from a total of 174 schools participated in the workshops during the period 1974-77.

Special subject area workshops were also offered at the junior and/or senior high school levels. These included home economics, general science, chemistry-physics, machine shop, building construction, social studies, mathematics, and drafting.

Development of curriculum materials. Small committees of classroom teachers prepared curriculum materials for subject areas requiring supplementary material. One example is the "Metric Measuring Guide for Elementary School Mathematics Teachers"(Calgary Board of Education, 1975), distributed to every elementary teacher, suggesting the scope and sequence for the measurement units from K-6 along with student activities appropriate for each concept. Some of the supplementary materials were presented in workshops; others were sent directly to classroom teachers.

Parent workshop program. Parent workshops, stressing consumer awareness, were held in schools or community halls at the request of a school. Each workshop consisted of two 2-1/2-hour evening sessions. By the end of the three-year program, 30 parent workshops had been offered in the Calgary school system. In addition, this workshop was offered in three separate sessions to the public through the Continuing Education program.

Non-teaching workshop program. In response to requests for metric information and workshops from nonteaching groups, half-day workshops were presented to:

1. School secretarial staff (five workshops)
2. Curriculum services
3. Accounting and purchasing personnel
4. Central office and media services support staff (four workshops)
5. Media services consultants
6. School kitchen workers
7. City Hall metric coordinators
8. Education curriculum and instruction students at the University of Calgary

Information dissemination and other services. To ensure that new equipment and supplies purchased were metric where feasible and possible, lines of communication were established with all areas of the Purchasing Department and Media Services, and the results of this communication were forwarded to school personnel. Specific activities included:

- Reviewing metric audiovisual and print materials, manipulatives and kits;
- Developing a "Metric Equipment List" for school use;
- Assisting the Social Studies Team in the preparation of metric map, globe, and atlas recommendations; and
- Assisting the Technical-Vocational Team in the preparation of the equipment list for allocating the $50 000 expenditure for equipment in technical-vocational shops and labs.

Project Evaluation

Toward the close of the project in March 1977, surveys were conducted with students, teachers, principals, and parents to determine the degree of metric implementation and the degree of success in preparing the schools for metric conversion.

The student survey indicated that students responded more frequently with a metric unit, whether correct or not, than an imperial unit for 70% of the questions (the student was given a choice of using either metric or imperial units). These responses indicated that SI is becoming predominant in the Calgary schools.

Of elementary teachers surveyed, 77% said that they had attended a metric workshop. Of those attending, feelings of insecurity about SI dropped from 52% to 20%. Secondary teachers reported a 41% workshop attendance and feelings of insecurity dropped from 18% to 8%. The teacher survey also revealed that only 2% of elementary teachers and 14% of secondary teachers who are teaching measurement were using "imperial only" measures.

In the survey of principals, 81% felt that teacher preparation was adequate or very adequate. Metric implementation in elementary schools appeared to be nearing completion and good progress had been made at the secondary level. Principals reported that 85% of elementary schools began the implementation phase during the 1974-76 period and that 68% of the secondary schools use SI in most or all of their programs.

Of the parents surveyed, 91% reported insecure feelings about SI before attending a workshop, which dropped to 43% after attendance; 95% felt that the workshops were of assistance in learning SI; and 97% favored the implementation of SI into the school program.

Contributions of the Calgary Approach

The final report on the Calgary Metric Project offered the following comments on the task force approach to metric conversion:

> The Calgary Board of Education's approach to implementing metric into the school system appears to have been unique in Canada....The structuring of a new and distinct curriculum team...has placed the major proportion of metric conversion on a short-term goal basis with very attainable objectives. The human resources and finances were made available. (Hall, 1977, p.22)

The report pointed out that the usual approach has been to give the responsibility of metric conversion to mathematics resource personnel who are already overloaded with the everyday demands of their programs, and to allocate a supply budget for the purchase of metric equipment. This approach tends to result in a limited workshop program, usually one teacher per school, and central purchase and distribution of equipment supplies. The Calgary approach, according to Hall, made four major contributions to metric conversion:

1. A K-12 approach to metric conversion.
2. Coordination of the implementation of SI into different curriculum areas.
3. The identification of an individual in the system who can be contacted for assistance and information regarding metric conversion.
4. The presence of an individual whose prime task is metric conversion, and who can pursue this exclusively without

> the crisis type interruptions that are encountered by many of the regular curriculum teams. (p.22)

Hall, in his concluding comments of the final report, said,

> One disadvantage to this approach is that at the end of the assignment, the individual who has been responsible for metric conversion takes on another assignment, and it becomes the responsibility of other curriculum teams to carry on the duties previously assumed by that individual. However, this transition can be simplified by involving as many curriculum teams as possible in the initial stages of the project. (p.22)

Nova Scotia Teachers College SI Metric Resource Kit

In keeping with the reminder, "Metric conversion and its implications for curriculum represents a leading challenge in Canadian public education, now and for the years immediately ahead," each member of the Nova Scotia Teachers College 1977 graduating class received a well-filled SI Metric Resource Kit. The kit, containing 30 booklets, charts, posters, and other items selected for their relevance to the work of the elementary school teacher, was compiled by a mathematics education student "Task Force for Metric Preparedness of Graduating Students."

Some of the specific items included in the kit were:

- "Come On Into the Metric Kitchen"(Agriculture Canada)
- "Hang me ups"(Metric Commission Canada)
- "How to Write SI"(Metric Commission Canada)
- Metric Canada Metricube (Metric Commission Canada)
- Educational supplies catalog
- Sector Plan summaries (Metric Commission Canada)

According to an explanatory brochure, "The kit represents the end-product of a search, of several months duration, for valid and useful material to constitute a metric resource file for the beginning teacher"(Nova Scotia Teachers College, 1977, p.1).

The graduating students were given the advice, "The quality of metric instruction in your classroom is your responsibility--no one else's. This kit, we sincerely hope, places at your fingertips all that you need for a good start. We'd suggest two signs for your desk... : Go Metric and Harry Truman's classic, The Buck Stops Here" (p.4).

Converting to SI in Ontario School Shops

While this 36-page publication (Ministry of Education, Western Ontario Regional Office, 1975) is directed to school shop teachers and administrators in Canada, it contains much relevant information for their counterparts in the United States who might be considering a changeover to SI in the industrial arts curriculum. Five major areas of concern are discussed:

1. Industry and the schools
2. Conversion of machines and equipment
3. Costing
4. Standardization
5. Retraining of teachers in SI

Industry and the Schools

A major concern in conversion of industrial arts programs in secondary schools in Canada has been that the schools, having set a target date of 1978 for complete conversion, would be at least two years ahead of industry in general, according to estimates. Thus, students would be leaving secondary schools and entering industry some time before industry itself has converted. These students could find themselves plunged into an imperial or dual measurement environment. If the education system does in fact convert completely from kindergarten through grade 12 in every department, the possibility presents itself that graduates will be unable to comprehend and properly calculate and manipulate imperial units. Two solutions presented in the report are that the industrial arts program should prepare the graduate to feel comfortable and confident in both systems, or that industry should provide on-the-job training in the imperial system if necessary.

Conversion of Machines and Equipment

In regard to conversion of machines and equipment, it is necessary to determine what is gained by conversion or lost by nonconversion. One example discussed in this publication is the conversion of an engine lathe to cut metric threads. Many threads are now manufactured by rolling, die forming, or on automatic machines. The skills involved in cutting an imperial thread are similar to those required in cutting a metric thread; the difference is in thread form and pitch. Therefore, the cost of completely converting a lathe to metric must be weighed against priorities and student and curriculum needs. Some shop machines, such as the wood planer or the drill press, can be converted merely by replacing a scale.

Costing

The following step-by-step method is presented for estimating the cost of converting facilities:

(a) Prepare an inventory.
(b) Decide what to do with each item.
(c) Decide what procedures to adopt.
(d) Determine curriculum relevancy.
(e) Set up an action plan.

Standardization

Changeover to SI will require that existing standards be changed. An opportunity exists here to make national standards conform as closely as possible to international standards. The organization responsible for international standards is the International Organization for Standardization (ISO) with its membership delegates from the major industrial nations. Canada is a member nation; the Canadian counterpart is the Standards Council of Canada (SCC). According to the Ontario report, it is obviously necessary that teachers and administrators of industrial arts programs be aware of new or impending standards.

Retraining of Teachers in SI

It is possible that the biggest problem in conversion of industrial arts curricula will not be equipment conversion but teacher conversion. Teachers (and administrators) of industrial arts curricula have specific needs and, obviously, not the same needs, due to the wide range and diversity of subjects.

Metric workshops such as the following are suggested to meet these needs:

- Awareness
- Measurement
- Basic and Derived Units
- Nomenclature
- Supplies and Equipment
- Derived Units (Advanced Session)
- Living in a Dual World
- Teacher Development Strategies

In general, information should be presented on a "need-to-know" basis in order to avoid overwhelming personnel with information they are not likely to use.

Publications of Metric Commission Canada

In addition to the development and dissemination of Sector Plans, the Metric Commission has been responsible for developing awareness and informational materials which could well serve as a model for the U. S. The materials produced over the years of the Commission's operation range from "A Guide to Metric Conversion for Municipalities" to a slide-rule type "Metric Price Comparator," with posters, leaflets, "Hang me ups" and Sector Plan summaries in between.

The immensity of the Metric Commission's program can well be appreciated when it is realized that each publication has a French-language counterpart, either included with the English version in one publication or published as a separate document. To illustrate the breadth of the Commission publications, some examples are listed below.

Awareness Booklets

"Moving to Metric"

"Introduction to the Metric System" (originally compiled and published by the Manitoba Department of Education)

Posters

An example of one of the "Think Metric" posters is shown in Figure 4. Many topics were covered, including Celsius temperature, windspeed, and metric graffiti.

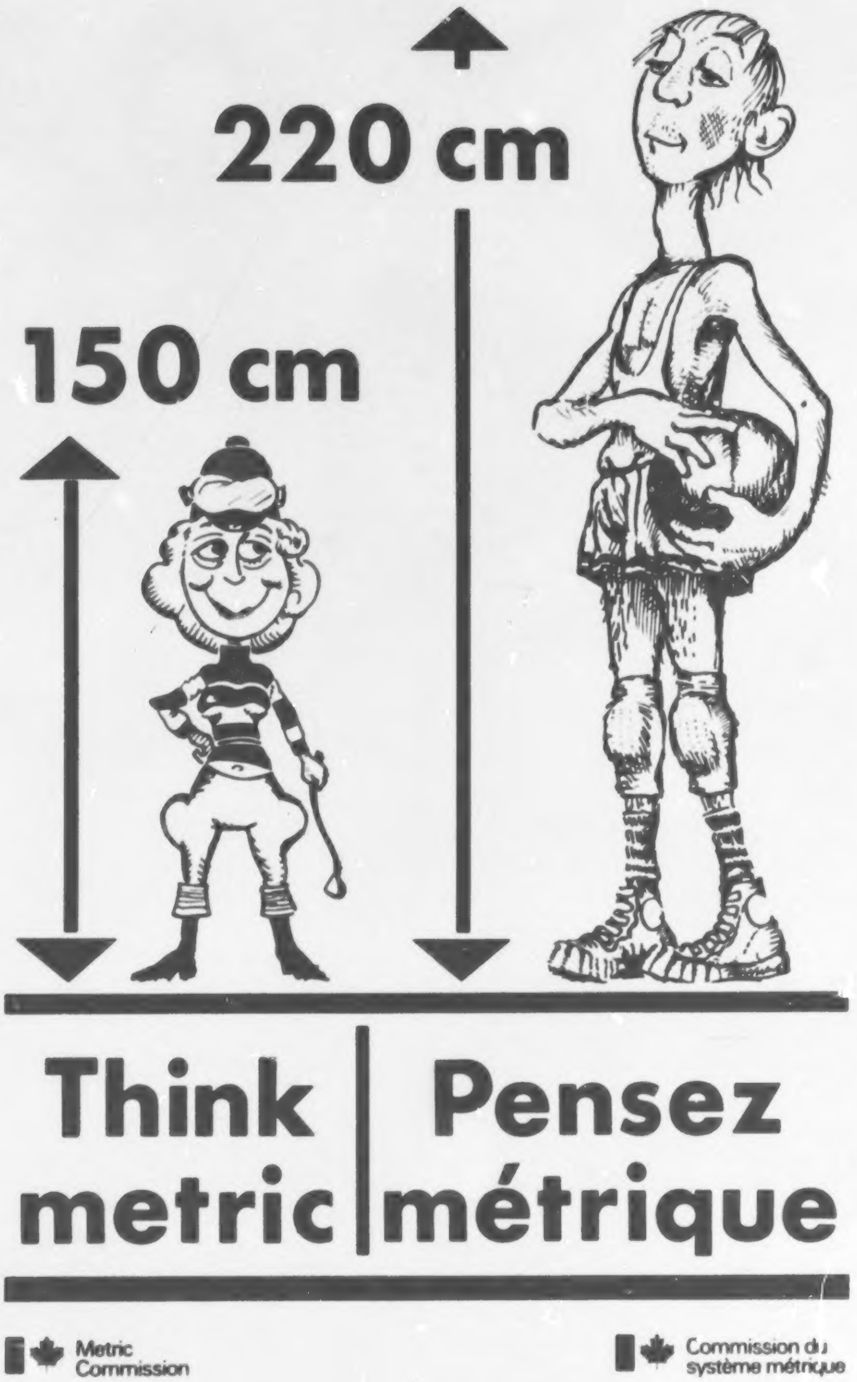

220 cm
150 cm
Think metric
Pensez métrique
Metric Commission
Commission du système métrique

Figure 4. Example of Canadian poster to encourage "Thinking Metric."

"How To" Booklets

"How to Write SI"

"How to Launch Metric Conversion in Your Organization
1 - Investigation Phase"

"A Guide to Metric Conversion for Muncipalities"

"Hang me ups"

The "Hang me up" or "Pique-moi au Mur" is a colorfully printed, 10 cm X 21 cm card which can be tacked up in a conspicuous place for day-to-day reference. Some of the topics covered are:

- Volume (ml and l)
- Volume (mm^3, cm^3, m^3)
- Length
- Area
- Temperature
- Atmospheric Pressure
- Metric Precipitation
- Mass
- Highway Speed

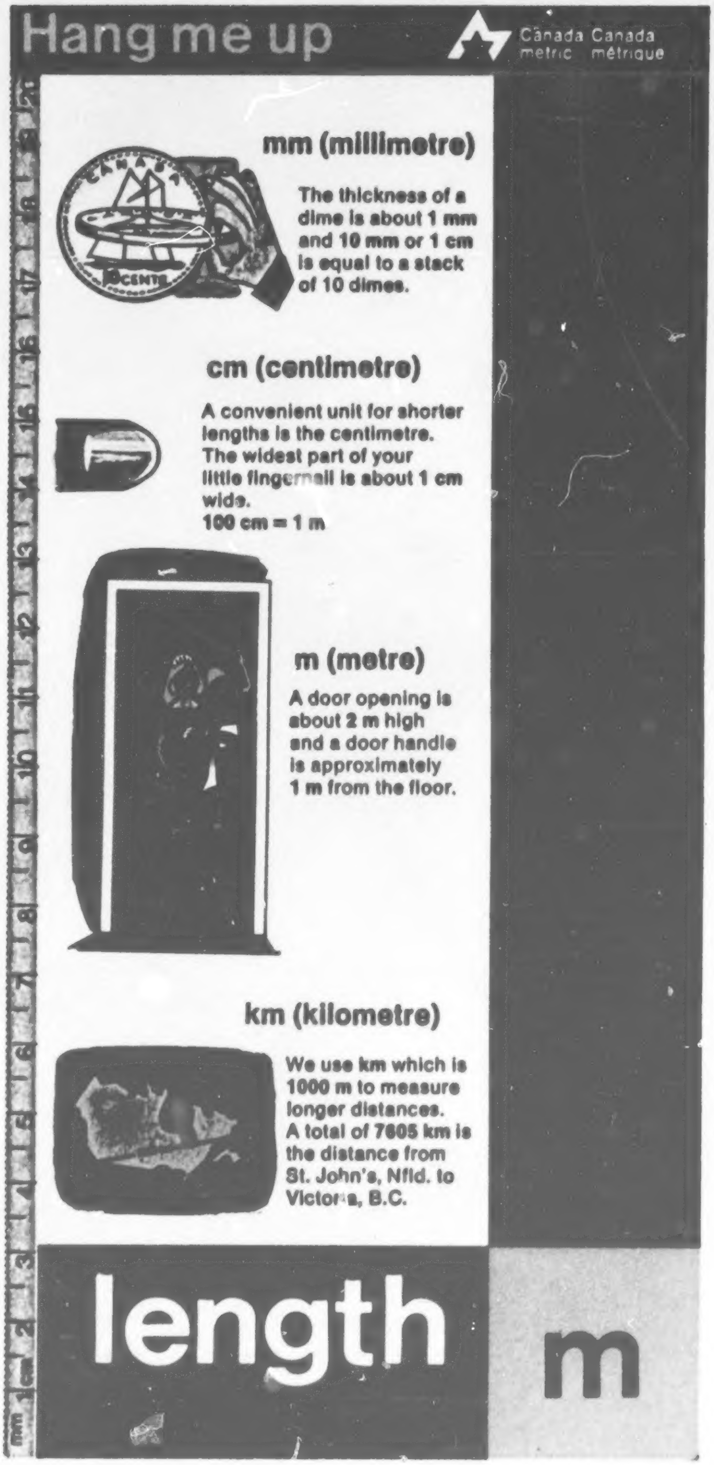
An example of a "Hang me up" is shown in Figure 5. Each one is printed in French on the reverse side.

Metric Price Comparator

The comparator includes price comparisons between imperial and metric measures for liquids (100 ml to 5 l) and solids (100 g to 5 kg), as well as yards vs. metres, inches vs. centimetres, and Fahrenheit vs. Celsius temperature scales (40 to 300°C).

"Metric Monitor"

This monthly tabloid-size newspaper, devoted to metric events and information, has been cited several times during the course of this report. With a circulation of some 160 000, it deserves recognition for its readability.



Hang me up

Canada metric
Canada métrique

mm (millimetre)

The thickness of a dime is about 1 mm and 10 mm or 1 cm is equal to a stack of 10 dimes.

cm (centimetre)

A convenient unit for shorter lengths is the centimetre. The widest part of your little fingernail is about 1 cm wide.
100 cm = 1 m

m (metre)

A door opening is about 2 m high and a door handle is approximately 1 m from the floor.

km (kilometre)

We use km which is 1000 m to measure longer distances. A total of 7605 km is the distance from St. John's, Nfld. to Victoria, B.C.

length

m

Figure 5. An example of a "Hang me up."

XII. SPECIAL AREAS FOR POLICY DEVELOPMENT

Canada's National Symbol for Metric Conversion

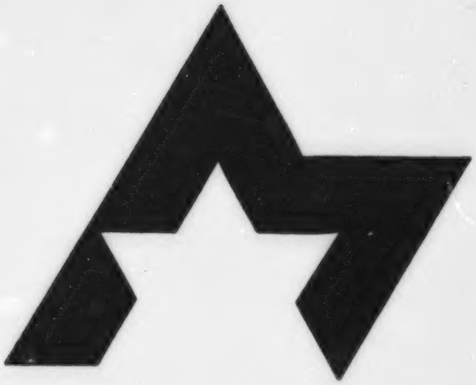
One of Canada's special contributions to metric conversion policy and practice was the development and use of a national symbol for metric conversion. While other countries involved in metrication in recent years have also seen fit to establish a symbol for conversion, Canada is unique in its national usage of such a symbol as a quality control device.

The Canadian Symbol for Metric Conversion, a stylized "M" enclosing a symbolic maple leaf (see Figure 6), was registered under the Trade Marks Act and formally adopted by the Metric Commission in October 1973. S. M. Gossage, then Chairman of the Commission, announced the intent of the Symbol in his introductory message in the usage manual:

> Symbols tell the story, they translate a large body of detailed information into one readily-identifiable form which brings to mind all sorts of data, feelings and ideas about an individual firm, a large corporation, a regional concept or a nation-wide movement. This is the intention of the National Symbol for Metric Conversion. (Metric Commission, 1974)

The Symbol is intended to identify materials, supplies, publications, and products that conform to the National Standards of Canada on SI and metric practice, as well as to the Commission's policies on metric conversion. Specific application must be made for permission to use the Symbol. While the actual use of the Symbol is free of charge, in the case of publications and related materials, the organization applying for use is charged a flat hourly rate (currently $25 per professional hour) to cover the screening process. When used according to the established policies of the Metric Commission, the Symbol indicates that the metric symbols and units are in accordance:

> with the National Standards of Canada: "The International System of Units" (CAN3-Z234.2-76) and the "Metric Practice Guide" (CAN3-Z234.1-76) and that the application of the symbol is not contrary to any of Metric Commission Canada's policies on metric conversion. It should be noted that recommendations contained in these standards are accepted by Metric Commission Canada as mandatory. (Metric Commission Canada, 1977b, p.6)



> Once this Symbol becomes widely known, it will be almost instinctively identified as standing for metric conversion in Canada: it will mean the system of measurement, the energies required to learn that new system, the concepts involved in visualizing the units of the system. Wherever it appears, the symbol will stand for the International System of Units, or SI, the form of metric measurement being adopted by Canada.
>
> But it will mean more. Because the adoption of a new system of measurement involves the process of change, the Symbol will come to mean change, and ready adaptation to that change. It will symbolize too, the ability to adapt; to have the flexibility to successfully cope with new situations. The importance of this type of image is readily apparent.

-excerpt from Chairman's Message,
Canada Metric Imprint Usage Manual,
Metric Commission, 1974

Figure 6. Illustration of Canada's National Symbol for Metric Conversion.

According to the Metric Monitor of September 1977 (Metric Commission Canada, 1977b, p.6):

- The article (material, supply, publication or products) on which the Symbol is requested to be used must be a Canadian-made end-product.
- The article is related to metric conversion in Canada or brings attention to the metric aspects of a product or service.
- The SI symbols and units used on the product or in the publication are in accordance with the two National Standards of Canada dealing with SI Metric.
- The proposed use of the Symbol must be in accordance with the Usage and Technical conditions set forth in the Canada Metric Imprint Usage Manual.
- The article does not rely solely on a simple conversion from customary units into metric equivalents for its claim to be a metric product. It must reflect good metric practice. Dual labelling must be avoided. Quantitative comparisons must be avoided, but qualitative comparisons are not precluded; e.g., 500 g is a little more than a pound, but not 500 g is 10% more than a pound.
- The article does not indicate by direct reference or implication that the Symbol is a certification or a Seal of approval of the quality, the contents, or the suitability of the product itself.
- The Symbol must not be used on drawing blanks, folder covers, letterheads, etc., unless the contents are submitted for screening in each instance. The Symbol is associated with specific contents and is not a "blanket coverage."
- The article, notwithstanding its technical compliance with SI, does not in any way discredit, nor is contrary to the established policies of Metric Commission Canada on metric conversion.

Impact of the Metric Symbol in Education

While the Symbol has frequently been employed to designate the packaging of products in round metric quantities, its major pedagogical contribution has been its appearance on textbooks and other instructional materials. According to Allen (1977b), "Use of the logo has been sufficiently widespread [by 1977] that the classroom teacher will not need expertise in the finer points of SI to make selections. The logo assures metric correctness, leaving the teacher to focus on pedagogical considerations" (p.11).

Throughout the eight provinces where we conducted our interviews, the general reaction to the Symbol was positive. The need for such a quality control device on metric texts and materials was universally recognized. Only three problem areas were uncovered during the course of our interviews:

1. Some indication of misuse of the Symbol by suppliers during the early years. These problems apparently have been resolved by further communication and the threat of possible legal action.
2. Especially during the first years, a lack of knowledge on the part of teachers and others concerning the meaning of the Symbol and the fact that its use indicates proper SI only and not necessarily good pedagogy. A leaflet is now available from the Metric Commission, outlining the procedure to be followed in applying for the Symbol.
3. The accusation that the Canadian Government Specifications Board, the agency responsible for the screening of the materials, was too slow and too "picky" in its review. One area of contention was the requirement to avoid any quantitative comparisons between imperial units and metric units. Arguments also arose between the Board and the authors of publications over whether some of the corrections required by the Board interfered with good pedagogical practices, and whether some of the specific recommendations of ISO (International Organization for Standardization) should be tempered a little when teaching young children. These corrections applied not only to SI units but also to those imperial units "accepted for use"; for example, the requirement to symbolize "minutes" rather than using the full word in conjunction with a number (e.g., 20 min rather than 20 minutes). An arbitration board is now in existence to deal with such issues.

Despite these rather minor problems, it appears that the use of such a national symbol as a quality control indicator for metric practice has been a major force for improving the quality of metric education materials.

Observations on the Metric Commission

A number of comments on Metric Commission Canada have been noted throughout the course of this report. Many of our respondents have acknowledged the role that the Commission has been playing since the early days of the conversion program. There is no denying the fact that Metric Commission Canada has made truly major contributions as the central coordinator of this massive change to the metric system. The progress being made toward the goal of an all-metric Canada is all the more notable in the light of the closely guarded independence that is so strongly felt at the provincial level. Provinces look very critically (if they look at all) on the edicts emanating from the federal government or its official agencies. But in the case of metric conversion, even in the midst of the furor over language and separation, there appears to be a surprising coordination in the movement of the provinces toward the metric system. No doubt the provinces recognize that, for the good of each one, Canada cannot exist half-metric and half-imperial.

Among the major responsibilities of Metric Commission Canada is that of public awareness. In meeting this responsibility the Commission has produced an amazing array of quality materials, as already noted. This contribution was repeatedly mentioned during our field interviews. At the same time, however, a number of respondents noted that the Commission played too passive a role in educating the general public. According to these individuals, the Commission was too often a "responder" rather than an "initiator." Typically, if you wanted a publication you had to ask for it; and the general opinion was that the Commission was not particularly active in either disseminating information as to what materials were available or in distributing these materials on a mass basis at its own initiative. Many have felt that the Commission has relied too much on the voluntary efforts of concerned citizen groups to distribute its educational materials.

Some suggestions for improvement in this area were: first, sending certain materials to all individuals to inform them how metric conversion would affect them and how they could prepare during the transition phase. Obviously, the impact on the budget would be very great, but it was considered unfortunate that many of the very excellent materials produced by the

Commission were not having as great an impact as they deserved because of their limited distribution.* A recommended approach for reaching more adults was to include appropriate metric information leaflets along with other broad-scale mailings, such as pension checks or public utility bills. Second, it was suggested that special efforts be made to keep educational leaders, as well as leaders in other fields, regularly informed about what materials were available from the Commission. Finally, it was recommended that mass media be used more frequently. It has appeared to some individuals at least that the power of radio has tended to be overlooked in favor of the glamour of TV.

The job of public awareness, however, need not rest solely on any one government agency. Other agencies as well as private industry can, and ideally should, share the load. In Canada, two examples of businesses that assisted in promoting metric awareness were the Toronto Dominion Bank and Metropolitan Life of Canada. Toronto Dominion Bank distributed a series of very striking posters promoting the conversion program; while Metropolitan Life of Canada supplied schools with a set of health-related posters explaining the new system, along with suggested metric activities related to body mass, height, and temperature.

Related Issues of Interest to Metric Educators

In 1976, the Canadian Standards Association Committee on Metric Practice prepared a National Standard (CAN3-Z234.4-76) entitled "All-Numeric Dates and Times" (Canadian Standards Association, 1976). This Standard was formally approved by the Canadian Standards Assocation Policy Board and the Standards Council of Canada. It is based on two International Standards: ISO 2014-1976, "Writing of Calendar Dates in All-Numeric Form," and ISO 3307-1975, "Information Interchange - Representations of Time of the Day." Recognizing that the writing of calendar dates and the 24-hour clock are not metric issues per se, we feel that the increasing usage by many educators in Canada and the fact that this Standard was prepared by a metric practice committee suggest that both issues may be of interest to educators concerned with metric conversion.

---

*In contrast, the Metric Conversion Board of Australia made special attempts to reach all Australians. The publication Metric Conversion and You (Metric Conversion Board, 1972) was deposited in every mailbox in Australia. This publication was probably the teacher's main source of basic metric information as well (Chalupsky, et al., 1975). A more lighthearted example of universal dissemination of metric information was the issuing of four cartoon-style stamps commemorating Australia's conversion to SI and showing how metric conversion would affect people's daily lives (Chalupsky, et al., 1974).

International Dating

The Canadian Standard acknowledges the misunderstanding that has resulted from different practices in the writing of dates in all-numeric form. For example, 3-12-77 can mean either the 12th day of March or the third day of December. To eliminate this problem, the Standard specifies that, when an all-numeric date is used, it shall be written in descending order as follows: 1977-03-12, to indicate the 12th day of March 1977. Two digits may be used for the year when no possible confusion can arise; the four-digit form should be used during the first 31 years of any century to avoid confusion with days. Except for data transmission, a hyphen or a space shall be used to separate year, month, and day.

While by no means universal, there is definitely a trend in Canada for this international dating practice to be used in business as well as in education. Quebec, for example, is implementing this practice in education--without fanfare--at the same time as it converts to SI.

The 24-Hour Clock

The Canadian Standard also encourages the writing of the time of day in a manner that is independent of language. Specifically, it establishes the following sequence when using the 24-hour timekeeping system: two digits to represent the hour; two digits, the minute; and, if required, two digits to represent the second. Only the colon is used as the separator. (Midnight is represented either as 24:00:00 or 00:00:00.) When the all-numeric form is used to represent both date and time, the following form is used: 1977-03-12-14:09, to indicate two hours and nine minutes past noon on the 12th day of March 1977. In contrast to the military practice of referring to 14:00 as "fourteen hundred hours," the Standard suggests that 14:00 be spoken as "fourteen," "fourteen hours," or "fourteen zero zero."

While the 24-hour clock is strange to most civilians in the United States, the airlines and the railroads in Canada use it, and 24-hour clocks are seen in various terminals as well as in some office buildings and hospitals. However, there does not appear to be any major movement to use the 24-hour clock in everyday Canadian life, at least not in the immediate future. One exception is in Quebec where it is being incorporated, along with ISO dating, in their metric education program.

XIII. CONCLUSIONS AND RECOMMENDATIONS

Through a series of over 40 interviews with metric education leaders in eight provinces, supplemented by an intensive review of relevant documents and correspondence with concerned leaders in Canadian metric conversion, we have attempted to identify the elements of metric education in Canada that have the greatest potential for improving the state of the art. Our primary goal was to learn from the experiences of recognized leaders in the conversion effort rather than to appraise the overall progress of the conversion program. Throughout the course of this report we have attempted to distill these experiences and to summarize the views of many individuals. The following conclusions are presented along with specific recommendations for improving metric conversion in the United States.

- Canada's long-range planning for metric conversion presents a model worthy of careful, continuing study.

  The four phase program of Investigation, Planning, Scheduling, and Implementation, supported by well thought out national and provincial plans, is providing Canada with an exceptionally detailed means of planning for, and measuring the progress toward, its goal of nationwide adoption of the metric system.

  While no government program is ever perfect, Canada's carefully planned sequence of metric conversion events in areas of high public visibility presents an excellent example of public education and involvement. Leaders in the U. S. can learn much by studying the progress, as well as the problems, of Canadian metric conversion.

- Strategies for introducing SI into the schools can be designed to provide a gradual transition on a year-by-year basis or more rapid conversion with a "blitz" campaign; however, comparative effectiveness data are lacking.

  The gradual year-by-year introduction of SI, starting with grade 1, provided the maximum amount of preparation time and the least pressure on Canadian teachers. Such a leisurely pace, however, requires a very lengthy conversion program, in contrast to the "blitz" approach where all grades are involved at the same time. One possible compromise among the various strategies was to begin with a block of several grades at the earliest elementary level and move to the next higher block each year.

In-depth information on the comparative effectiveness of these strategies and the problems associated with each approach would be helpful in the development of a nationwide metric education program. To obtain this information, a further study of Canadian schools employing a variety of changeover strategies is recommended.

- Top-level commitment, continuing communication, and authoritative reference materials are essential elements for involving teachers and administrators in metric conversion.

The success of metric education rests on a foundation of teacher and administrator support. To gain and hold this support in Canada, there was ample evidence of top-level commitment at the national level, the province, and the school board.

If metric education in the United States is ever to reach the stage that is present today in Canada, there needs to be clear evidence of this commitment from the federal government and the U. S. Metric Board, as well as from the state and local governments. Educators need to be part of a national team, not the only players on the field.

Evidence of this teamwork can be reflected in many other ways. One way is by involving school board members and senior administrators in schoolwide metric programs that extend beyond the classroom. Two areas for early involvement should be competitive sports and the school library.

Another indicator of teamwork is the continuing attempt, via newsletters and other media, to keep educators abreast of plans and progress in metric conversion. Providing teachers with ample released time and funds to prepare for teaching SI is yet another means of showing commitment and teamwork.

The need for authoritative reference materials is so well recognized that it requires little justification. One such example in Canada that deserves attention as a model because of its appealing style and attractive illustrations is the document now titled The Metric Guide, described on pages 73-75.

- Metric conversion presents an ideal opportunity to evaluate and overhaul the entire program of measurement instruction.

Educators are in agreement that the traditional program of teaching measurement has been a major weakness in mathematics education. Conversion to the metric system provides the opportunity to rethink the entire measurement program and bring it in line with what is known about the cognitive development of children. New measurement programs in Canadian schools are relying heavily on student activities using manipulative materials; estimation has become a vital part of the program.

Reflecting the fact that SI is decimal in nature, many Canadian schools are increasing their emphasis on decimals, especially in the early grades. It appears that decimals can be introduced effectively as early as grade 3, with formal operations beginning then or in grade 4. Along with this emphasis on decimals, the time spent on operations with fractions will very likely decrease; simple fractions will still be taught in the early grades but the manipulation of fractions may well be postponed to grades 7-8.

- Among the problems in metric education, the needs for updating instructional materials and for overcoming administrator and teacher hesitancy are primary.

The lack of high quality teaching aids in metric education is fast being remedied; but more should be done to bring textbooks up-to-date, especially in the physical science and social science areas. Teachers and administrators alike need to pressure for textbook improvements, but in the meantime must accept the challenge of developing appropriate supplemental materials. Because administrator hesitancy can have a serious impact on teachers and the overall progress of metric education, special effort should be made to ensure that administrators understand the priorities of metric education and the need for a carefully planned program. With enthusiastic administrators and signs of definite progress at the national level, the problem of teacher hesitancy can be greatly reduced.

- The gaining of parent and community support for metric education--so crucial for program success--can be enhanced through handout materials and special information campaigns.

Capitalizing on the power of children to educate parents (via handout materials) is a technique that is being employed in some Canadian schools, in addition to special school-sponsored parent workshops. Concerned consumer representatives in Canada sense the need for information saturation campaigns, involving displays and demonstrations, new product fanfare, increased media coverage, handout literature, special information centers, and brief mini-courses.

- The creative support of the mass media is one of the most difficult, but potentially most rewarding, avenues for fostering metric awareness.

Despite the many educational efforts in Canada, the typical columnist has yet to become committed to the challenge presented by metric conversion. Nevertheless, there are a number of examples in Canada where creative representatives of the media have teamed with public-spirited educators to instruct and involve the general public. The full potential of the radio and the print media has yet to be realized. Further study of the experiences with mass media in Canadian metric education would be a worthwhile follow-on to this report.

- The use of a national symbol as a quality control device for metric materials represents a unique contribution of the Canadian metric conversion program.

Canada's national symbol for metric conversion has been employed effectively as a tool for the identification of instructional materials which conform to national policies on metric usage. As a result, educators are able to focus their selection of classroom texts and other materials on pedagogical considerations rather than be burdened by having to screen such materials for correct SI usage. The adoption of a similar logo in the United States merits serious consideration.

- Underlying every stage of metric education is the need for clear and complete communication.

  This need has appeared over and over again no matter what area of metric education--or metric conversion--is discussed. The importance of good communication to everyone cannot be overemphasized. Generalizing from the Canadian experience, it is very likely that the leaders in metric conversion in the United States, as well as a goodly number of the general public, will expect the U. S. Metric Board to play a very active communication role. The Board would be well advised not to try to assume this mammoth task on its own, but rather to enlist the help of government agencies as well as private industry. By serving as a leader in metric awareness communication and at the same time as an effective coordinator of the communication efforts of others, the Board should be able to accomplish its expected role and live within a realistic budget.

- One final secret of success in metric conversion is "Don't lose your sense of humor."

  As important as the mission of metric education is, educators would be well advised "not to do battle with every little bump or snag that comes along."

  For the benefit of the metric education program, and as a means of preventing ulcers, many successful educators have made deliberate efforts to inject a sense of humor into their teaching programs, while at the same time being sensitive to the anxieties of the public. The moral of the story is--metric education and having fun can indeed go hand-in-hand.

REFERENCES

Aho, C., Barnett, C., Judd, W. P., & Young, S. Measure matters^{tm}: Teacher's guide for levels a, b, & c. Palo Alto, California: Creative Publications, Inc., 1976.

Alberta Department of Education. SI, a Newsletter About Conversion to the Metric System, September 1975.

Alberta Department of Education. SI, a Newsletter About Conversion to the Metric System, February 1976, 3(1).

Alberta Department of Education. Metrication policy, no date.

Alberta Housing & Public Works. Metric memo to consultants. Edmonton, Alberta: Alberta Housing & Public Works, May 11, 1976.

Allen, H. D. "My mass is 20 kg": Aspects of Canadian and international progress toward an SI way of life. An address before the SI Metric Conference, "Metrication Is Everybody's Business," sponsored by the Delaware Department of Public Instruction and the University of Delaware, University of Delaware, Newark. May 4, 1976.

Allen, H. D. An SI Canada: Reality and challenge at commitment plus seven. Opening address before the Industrial Education Teachers Spring Conference, Nova Scotia Teachers College, Truro, Nova Scotia, April 1977. (a)

Allen, H. D. Educational implications of a metric tomorrow. Journal of Education, Summer 1977, 4(4), 5-12. (b)

American National Metric Council. Boire reports metric conversion well underway in Canada. Metric Reporter, November 1973, 1(3), 8.

Boire, P. C. Progress toward metric conversion in canada. Address before the American Psychological Association Annual Convention, Montreal, Quebec, August 28, 1973.

Calgary Board of Education. Report of the Metric Feasibility Study. Calgary, Alberta, March 1974.

Calgary Board of Education. Metric measurement guide for elementary school mathematics teachers. Calgary, Alberta, 1975.

California State Department of Education. Inservice guide for teaching measurement (K-8): The SI metric system. (Pub. #SM4017). Sacramento, California: California State Department of Education, 1975.

Canadian Standards Association. National Standard of Canada: All-numeric dates and times. (CAN3-Z234.4-76). Rexdale, Ontario: The Canadian Standards Association, 1976. (a)

Canadian Standards Association. Canadian metric practice guide. (CAN3-Z234.1-76). Rexdale, Ontario: The Canadian Standards Association, 1976. (b)

Chalupsky, A. B., Crawford, J. J., & Carr, E. M. Going metric: An analysis of experiences in five nations and their implications for U. S. educational planning. Final report. Palo Alto, California: American Institutes for Research, 1974.

Chalupsky, A. B., Crawford, J. J., Carr, E. M., & McDonnell, P. Metric inservice teacher training: Learning from the English and Australian experience. Final report. Palo Alto, California: American Institutes for Research, 1975.

Consumers' Association of Canada. Easy metric, All you need to know about metric conversion. Ottawa, Ontario: Consumers' Association of Canada, 1976.

Consumers Union of United States, Inc. Going metric, what's in store for consumers. Mount Vernon, New York: Author, 1977.

Copeland, R. W. How children learn mathematics: Teaching implications of Piaget's research, Second edition. New York: Macmillan Company, 1974.

Council of Ministers of Education, Canada. The metric guide, Second edition. Toronto, Canada: OISE Publications, March 1976. (ISBN 0-7744-0127-3)

Edmonton Public School Board. Metric is for real. Metrigram, no date, Issue 4.

Government of Canada. White Paper on metric conversion in Canada. Department of Industry, Trade and Commerce, January 1970.

Hall, L. J. Final report on the Metric Project. Calgary, Alberta: Calgary Board of Education, 1977.

Hopkins, R. A. The International (SI) Metric System and how it works, Second edition. Tarzana, California: AMJ Publishing Company, 1974.

Hutton, L. Metric facts. Edmonton Journal, November 25, 1977.

International Organization for Standardization (ISO). Information interchange - Respresentations of time of the day. Ref. No. ISO 3307-1975(E).

International Organization for Standardization (ISO). Writing of calendar dates in all-numeric form. Ref. No. ISO 2014-1976(E).

Kirkland, B. Metric educational show to be expanded. Toronto Star, December 14, 1977.

Kirkpatrick, J. E. Teaching measurement. Elements, Translating Theory Into Practice, January 1975, VI(5). (Department of Education, The University of Alberta).

Lindstedt, S. A. Metrication. Education Canada, Spring 1976, 16(1), 16-19.

Manitoba Department of Education. The metric system: Supplement to the curriculum guide for mathematics, grades 7, 8, 9. Winnipeg, Manitoba: Department of Education, 1974. (mimeo)

Manitoba Department of Education. Metric conversion - Guidelines for school administrators. Winnipeg, Manitoba: Department of Education, 1975. (mimeo)

Metric Commission. Metric Commission first report. Ottawa, Ontario: Author, 1973.

Metric Commission. Canada metric imprint usage manual. Ottawa, Ontario: Author, April 1974.

Metric Commission. Metric Commission second report. Ottawa, Ontario: Author, 1975.

Metric Commission Canada. Third report: The planning phase. Ottawa, Ontario: Author, 1976. (a)

Metric Commission Canada. Sector 10.01, Elementary and Secondary Schools, metric conversion plan, First edition. Ottawa, Ontario: Author, 1976. (b)

Metric Commission Canada. Fourth report: Planning and scheduling. Ottawa, Ontario: Author, 1977. (a)

Metric Commission Canada. The Metric Symbol and how to use it. Metric monitor, September 1977, 4(9), 6. (b)

Metric Conversion Board. Metric conversion & you. Melbourne, Australia: Author, 1972.

Ministry of Education, Ontario. Policy statement on metrication: Conversion to the metric system in elementary and secondary schools of Ontario. Ontario: Author, no date. (Identification No. 74-75/4184).

Ministry of Education, Ontario. Ottawa Valley Newsletter, September 19, 1977.

Ministry of Education, Western Ontario Regional Office. Converting to SI in Ontario school shops. London, Ontario: Author, no date.

National Advisory Committee on Mathematical Education. Overview and analysis of school mathematics, grades K-12. Washington, D.C.: Conference Board of the Mathematical Sciences, 1975.

New Brunswick Department of Education. Policy guidelines on metric conversion in New Brunswick schools. Fredericton, N.B.: Author, 1975. (mimeo)

Nova Scotia Department of Education. Teaching SI metric. *Education Nova Scotia*, June 15, 1977, *7*(17), 18.

Nova Scotia Teachers College. *SI metric resource kit*. Truro, Nova Scotia: Nova Scotia Teachers College, Task Force for Metric Preparedness of Graduating Students, June 1977.

Ontario Teachers' Federation. *Teacher's metric handbook*. Toronto, Kingston, Ontario: Author, September 1973.

Piaget, J., & Inhelder, B. *The psychology of the child*. (Translated by Helen Weaver). New York: Basic Books, Inc., 1969.

Robinson, B. E. Metric conversion progress in Canada. An address to the United States Metric Association Conference, Portland, Oregon, April 22, 1978.

Saskatchewan Department of Education. Metric up-date. *Going Metric*, February 1975, *1*(2). (a)

Saskatchewan Department of Education. Policy statement on metric conversion in Saskatchewan schools. Memorandum to Superintendents, Directors of Education, Secretary-Treasurers and Principals. Regina, Saskatchewan: Author, 1975. (b)

Sauve, J. School organizations and conversion to the International Units System. Ministry of Education, Quebec newsletter, *Megnews*, June-July 1977, No. 18, 24.

Smith, E. P. The metric system: Effects on teaching mathematics. National Council of Teachers of Mathematics *Newsletter*, March 1974.

Sohns, M. L., & Buffington, A. V. *The measurement book*. Sunnyvale, Calif.: Enrich, Inc., 1977.

The education world is forcing metrication on us, MPs protest. *The Bookseller*, March 27, 1971, 1662.

Turner, L. W. How to metricate your lesson material. Edmonton, Alberta: Northern Alberta Institute of Technology, 1976. (mimeo)

U. S. Department of Commerce. *A history of the metric system controversy in the United States*. National Bureau of Standards Special Publication 345-10. Washington, D. C.: U. S. Government Printing Office, August 1971.

U. S. Department of Commerce. *NBS Guidelines for Use of the Metric System*. National Bureau of Standards Publication LC1056. Washington, D. C.: U. S. Government Printing Office, August, 1975.

U. S. Department of Commerce. The International System of Units (SI). National Bureau of Standards Special Publication 330, 1977 edition. Washington, D. C.: U. S. Government Printing Office, 1977.

U. S. Metric Association. Metric units of measure and style guide. USMA Publication 8. Boulder, Colorado: Author, 1976.

Western Ontario Region, Ministry of Education. To be or not to be. Western Metric News, Spring 1977, 3(2), 1.

Windsor Roman Catholic Separate School Board. Decimal activity kit. Windsor, Ontario: Author, no date.

APPENDIX A

Data Collection Tasks for the Exploration of Canada's Metric Conversion in Education

Data Collection Tasks for the Exploration of Canada's Metric Conversion in Education

The project data collection tasks can be categorized under five major areas:

1. Document review
2. Development of interview guides
3. Field data collection
4. Follow-up survey of educators
5. Survey of consumer respresentatives

Document Review

During the five years that AIR has been active in the metric education area a large collection of Canadian documents and educational materials has been accumulated. These materials include formal directives issued by government agencies at the federal and provincial levels plus reports, educational materials, and personal correspondence from individual educators and administrators at all levels of education. At the start of the study, special efforts were made to identify new sources of information and to obtain additional documents. These resources not only provided a wealth of information but also assisted us in identifying individuals whose experience in metric education merited further contact.

Development of Interview Guides

The next major task was to design an interviewing strategy and a series of interview guides which not only satisfied the major information needs as we saw them but also reflected what information educators across the country (as well as in Canada) felt would be of assistance in designing effective metric education programs. To achieve this objective, an editorial was presented in the May/June 1977 AIR METRI-GRAM (a bimonthly metric education newsletter originated by AIR in 1974) inviting readers to share in our research by responding to five questions:

1. What questions would you like to have answered about metric education in Canada?
2. What information areas would be most helpful in your development of metric education programs and activities?

3. What specific metric education problems should be probed in discussions with Canadian educators?
4. What information sources in Canada--agencies as well as individuals--do you feel would be most worthwhile to contact?
5. What other suggestions can you offer to make the final report of greatest value to U. S. educators?

Several key educators in the United States and Canada were also contacted directly for their advice.

Usable suggestions were received from five Canadian educators and eight individuals from the United States, representing elementary and secondary education, vocational education, colleges and universities in both the U. S. and Canada, and Canadian provincial representatives.

Based on the results of this effort, the major topics of concern were identified and organized under the following headings:

A. National Policy Issues
B. Guidance and Support
C. Organization and Scheduling of Metric Education
D. Teacher Training
E. Curriculum Development
F. Educational Materials and Equipment
G. Metric Education in the Community
H. Program Costs and Benefits
I. Miscellaneous Problem Areas

The draft listing of topic areas for field interviewing were then reviewed by several AIR staff members and the resulting comments were discussed with project staff. In addition, the proposed topics were forwarded to two educators with extensive experience conducting metric education programs, one in the U. S. and one in Canada. Respondents were asked not only to comment on the proposed topic areas but also to suggest any specific questions which they felt should be asked during the interviews.

Several interview guides were then developed, reviewed, and discussed with project staff, and the final versions prepared. It should be noted that the intent of these instruments was that they should serve as general guides for the types of information to be obtained while allowing for a high degree of flexibility, depending upon the particular level and experience of the individual being interviewed.

Field Data Collection

On-site data collection in Canada extended between September 15 and November 5, 1977. Three separate trips, covering approximately five weeks, were made to the Provinces of Alberta, British Columbia, Manitoba, Nova Scotia, Ontario, Quebec, Prince Edward Island, and Saskatchewan. The initial meetings with key contacts in each province were arranged typically through the efforts of Mr. George Desbarats, the Education Sector Plan Manager for Metric Commission Canada. These contacts, in turn, often made arrangements for additional interviews with metric education leaders in their respective areas.

Meetings were held with representatives of selected boards of education and with cognizant personnel at the provincial level, one of whom is a member of Metric Commission Canada and chairman of the Steering Committee representing education. In addition, interviews were held with two federal government staff and two consumer representatives. Altogether, some 41 individuals were interviewed, as shown in the table below.

SUMMARY OF INDIVIDUALS INTERVIEWED
DURING CANADIAN METRIC EDUCATION STUDY

Provinces Represented*	Ministry of Education Representatives	Representatives of School Boards
Alberta	1	1
British Columbia	1	2
Manitoba	1	
Nova Scotia	2	2
Ontario	3	11
Quebec	5	2
Prince Edward Island	1	
Saskatchewan	3	2
	17	20

*Plus two federal representatives and two consumer representatives

Follow-up Survey of Educators

During the organization and analysis of interview findings and the supporting documents, a number of interviews were identified where further information was needed. For each such interview, the specific information gaps were identified and a letter was sent requesting the additional information. Altogether, 22 requests for information were sent and the responses from all 22 individuals were received in time for inclusion in this report.

Survey of Consumer Representatives

During the original data collection trips in Ontario and Nova Scotia, interviews were held with two members of the Consumers' Association of Canada, both very active and interested in metric conversion. The information we obtained was so helpful that we subsequently wrote to six other provincial representatives of CAC concerned with metric conversion, in order to obtain their views on metric education especially as related to community involvement. Altogether, metric education information was received from six provinces. The questionnaire sent to the consumer representatives is summarized on the following page.

EXPLORATION OF CANADA'S TRANSITION TO METRICS IN EDUCATION (Survey of Consumer Representatives)

NAME ______________________________

ADDRESS: __________________________

____

1. What suggestions do you have for improving metric education in the schools and in the community?

2. What steps do you feel should be taken to achieve a greater level of community support for metric conversion?

3. What activities has CAC undertaken in your area to improve metric education in the schools and in the community?

4. What recommendations do you have for improving cooperation between school metric programs and the community?

5. Looking back on Canada's metric conversion activities to date, what things might have been done better, from the standpoint of consumer education and involvement?

Any other suggestions for teachers or administrators of metric education programs?

APPENDIX B

Activity List for Sector 10.01, Elementary and Secondary Schools

SECTOR ACTIVITY LIST **LISTE D'ACTIVITÉS SECTORIELLES**

Sector No. *Secteur n°*	Sector Title – *Nom du secteur*	Date	Document No. – *N°*	Sector No. – *Secteur n°*
10.1	ELEMENTARY AND SECONDARY SCHOOLS	23-01-76		10.1

Activity – *Activité*					Revisions – *Révisions*	
Number – *Numéro*	Title – *Nom*	Responsibility No. *Responsabilité n°*	Duration (Months) *Durée (mois)*	Remarks – *Observations*	No – *N°*	Date
				PRECEDES		
0000	Start Metric Conversion			ES0174-LS0174		
0001	Define Objectives, Policy & Strategy	100100	4	1401		
	EQUIPMENT					
0701	Identify Instructional Equipment to be Modified or Replaced	400900	12	0702		
0702	Specify and Analyze Changes or Alternatives	400900	6	0703, 0704		
0703	Consult and Inform Related Sectors	400900	4	0705		
0704	Recommend Priorities	400900	2	0705		
0705	Recommend Actions	400900	2	9999		
	MATERIALS AND SUPPLIES					
	TEACHERS' EDUCATION MATERIAL					
0801	List Presently Available Materials	100100	18	1004		
0802	Evaluate Teaching Materials	100100	10	0803, 0804		
0803	Recommend Required Materials and/or Revisions	100100	4	0805		
0804	Consult and Inform Related Sectors	100100	4	0805		
0805	Inform Teachers of Availability of Materials	100100	2	0806		
0806	Distribute Teaching Materials	100100	12	9999		
	BUSINESS SYSTEMS					
0901	Examine all Administrative Systems and Related Equipment	400902	2	0902		

SECTOR ACTIVITY LIST **LISTE D'ACTIVITÉS SECTORIELLES**

Sector No. *Secteur nº*	Sector Title – *Nom du secteur*	Date	Document No. – *Nº*	Sector No. – *Secteur nº*
10.1	ELEMENTARY AND SECONDARY SCHOOLS	23-01-76		10.1

Activity – *Activité*					Revisions – *Révisions*	
Number – *Numéro*	Title – *Nom*	Responsibility No. *Responsabilité nº*	Duration (Months) *Durée (mois)*	Remarks – *Observations*	No – *Nº*	Date
				PRECEDES		
0902	Specify Changes	400902	1	0903		
0903	Consult Related Sectors	400902	6	0904		
0904	Conduct Informational Workshops for Administrative Personnel	400902	6	0905		
0905	Determine Priorities for Change	400902	2	0906		
0906	Develop Changes	400902	3	0907		
0907	Implement Administration Systems Changes	400902	12	9999		
	RESEARCH AND DEVELOPMENT OF CURRICULUM					
1001*	Appoint Metric Conversion Committee for Curriculum	400904	2	1002		
1002*	Analyze Present Curriculum	400905	12	1003		
1003*	Identify and Recommend Specific Areas Requiring Curriculum Revisions	400905	6	1004		
1004*	Recommend Total Curriculum Revisions	400905	4	1005		
1005*	Obtain Approval of Departments of Education for Curricula Revisions	400904	6	0702, 0802, 1006, 1204 1253		
1006	Disseminate Information Relative to Curriculum Revisions	400904	2	1007		
1007	Implement Curriculum Revisions	400906	12	9999		

0201 42.3 (12/75)

*Indicates that activity is located on the critical path. The critical path determines the estimated time required to implement the plan. Any delay of activities on the critical path will result in an overall delay of metric conversion within the Sector.

SECTOR ACTIVITY LIST **LISTE D'ACTIVITÉS SECTORIELLES**

Sector No. Secteur nº	Sector Title – Nom du secteur	Date	Document No. – Nº	Sector No. – Secteur nº
10.1	ELEMENTARY AND SECONDARY SCHOOLS	23-01-76		10.1

Activity – Activité					Revisions – Révisions	
Number – Numéro	Title – Nom	Responsibility No. Responsabilité nº	Duration (Months) Durée (mois)	Remarks – Observations	No. – Nº	Date
				PRECEDES		
	EDUCATION AND TRAINING					
	TEACHER EDUCATION					
1201	Appoint Metric Conversion Committee for Teacher Education	400903	2	1202		
1202	Analyze Existing Systems	400903	6	1203		
1203	Identify Areas of Revision	400903	4	1204		
1204	Recommend Teacher Education Program Revisions	400903	2	1205		
1205	Implement Teacher Education Program Revisions	400903	12	9999		
	IN-SERVICE EDUCATION					
1251	Contact Teachers Organizations and School Boards	400900	12	1252		
1252	Encourage Joint Participation	400900	12	1253		
1253 *	Select and Educate Workshop Leaders	400900	12	1254, 1255		
1254 *	Develop Comprehensive Workshop Programs	400900	6	1256		
1255 *	Obtain Necessary Education Materials	400900	6	1256		
1256 *	Implement In-Service Training Programs	400900	12	9999		
	PUBLIC AWARENESS					
	PARENTAL ACCEPTANCE					
1301	Create Parental Awareness Programs at Provincial Level	400901	12	1302		

0201-42.3 (12/75)

SECTOR ACTIVITY LIST **LISTE D'ACTIVITÉS SECTORIELLES**

Sector No. *Secteur nº*	Sector Title – *Nom du secteur*	Date	Document No. – *Nº*	Sector No. – *Secteur nº*
10.1	ELEMENTARY AND SECONDARY SCHOOLS	23-01-76		10.1

Activity – *Activité* Number – *Numéro*	Activity – *Activité* Title – *Nom*	Responsibility No. *Responsabilité nº*	Duration (Months) *Durée (mois)*	Remarks – *Observations*	Revisions – *Révisions* No – *Nº*	Revisions – *Révisions* Date
				PRECEDES		
1302	Create Committee to Prepare Information Bulletin	400901	2	1303		
1303	Prepare and/or Identify Materials for Parents	400901	18	1304		
1304	Distribute Available Information to Parents	40020	2	1305		
1305	Hold Evening Workshops for Parents	400901	10	9999		
	STUDENT AWARENESS					
1351	Create Student Awareness Programs	400201	12	1352		
1352	Prepare and/or Identify Materials for Students	400201	12	1353		
1353	Distribute Materials to Students	400201	2	1354		
1354	Hold Student Assemblies	400201	10	9999		
	TEACHERS' SURVEY					
1371	Prepare Questionnaire	100100	5	1372		
1372	Distribute Questionnaire	100100	2	1373		
1373	Collect and Analyze Questionnaire Data	100100	2	1374		
1374	Direct Questionnaire Results to Needed Area	100100	1	1375/FS9		
1375	Distribute and Analyze Second Questionnaire	100100	6	1376		
1376	Direct Questionnaire Results to Needed Area	100100	3	9998		

0201-42.3 (12/75)

SECTOR ACTIVITY LIST **LISTE D'ACTIVITÉS SECTORIELLES**

Sector No. - Secteur n°	Sector Title - Nom du secteur	Date		Document No. - N°	Sector No. - Secteur n°	
10.1	ELEMENTARY AND SECONDARY SCHOOLS	23-01-76			10.1	
Activity - Activité					Revisions - Révisions	
Number - Numéro	Title - Nom	Responsibility No. Responsabilité n°	Duration (Months) Durée (mois)	Remarks - Observations	No - N°	Date
				PRECEDES		
	SECTOR PLAN MANAGEMENT					
1401*	Formulate Conversion Activities and Schedule	100100	4	0701, 0901, 1301, 1351,		
				1402, 1371, 1001, 0801,		
				1201, 1251		
1402	Distribute to Sectors Affected and Provinces	100100	2	1403		
1403	Submit to Steering Committee for Plan Concurrence	100100	2	1404		
1404	Submit to Metric Commission for Approval of Plan for	100100	2	1405, 1406		
	Publication					
1405	Monitor Related Sector Plans	100100	52	9999		
1406	Monitor and Report Progrcss	100100	52	9999		

0301-42.1 (12/75)

APPENDIX C

Advice on How to Avoid Embarrassing Classroom Situations During Early Presentations Using SI Units

PITFALLS TO GUARD AGAINST

Prepared by L. W. Turner 1976-03-30

These brief notes are intended to draw to your attention the possibility of embarrasing classroom situations which might arise during early presentations using SI units. It will be noted that many of the situations may arise because of assumptions made by you.

1. To assume the textbook ordered into the bookstore for your course will arrive for first time round of the course. Be prepared to cope without a textbook, in SI units.

2. To assume you are "bi-system" because you have done some reading and metrication of lesson material. Most of your knowledge is stored in memory in imperial units, when questions are posed by students, your fluency with SI may be put to critical test. To improve fluency, discussion sessions with other instructors may be productive.

3. To assume you can use all the old familiar imperial units formulae. In general:

   Fundamental formulae, O.K.
   Empirical formulae, Require re-working

4. To assume you can perform ad lib calculations or derivations on the chalkboard. It is quite easy to make errors because of lack of familiarity with the SI., e.g.

   Unit for power the watt W
   in base units $W = kg \cdot m^2 \cdot s^{-3}$

   Under classroom question conditions it is not the easiest of things to explain how a time unit to power minus three enters the right hand side. (Try it).

5. In basic classes to omit unit cancelation stages of worked examples. Because students may question units of the final answer, you will find yourself using up valuable time re-tracking through the calculation.

...2

6. On the chalkboard incorrect use of upper - lower case symbols.

7. Introducing fractions typically:

   1/2 kg   1/4 litre   3/4 tonne

   are especially easy to slip into.

8. The prefixes deci (d) and deca* (da) are easily confused, in general it is best to completely avoid the use of deca.

9. Using outdated metric texts based on c.g.s. or MKSA units especially for:

pressure	kg/cm^2
force	kgf or kp and dyne
capacity	cc and lambda
length	micron
energy	calorie and erg

10. Using American source material in which conversion factors for gallons↔litres are listed. Do not forget the smaller U.S. gallon.

11. Using U.K. or Australian source material in which conversion factors for tons↔tonnes are listed. Do not forget the U.K. (long ton) is 2240 lbs.

---

*AUTHOR'S NOTE: In Canada, the preferred spelling is "deca," while in the U. S. and Australia it is "deka." The symbol is "da" in all countries.